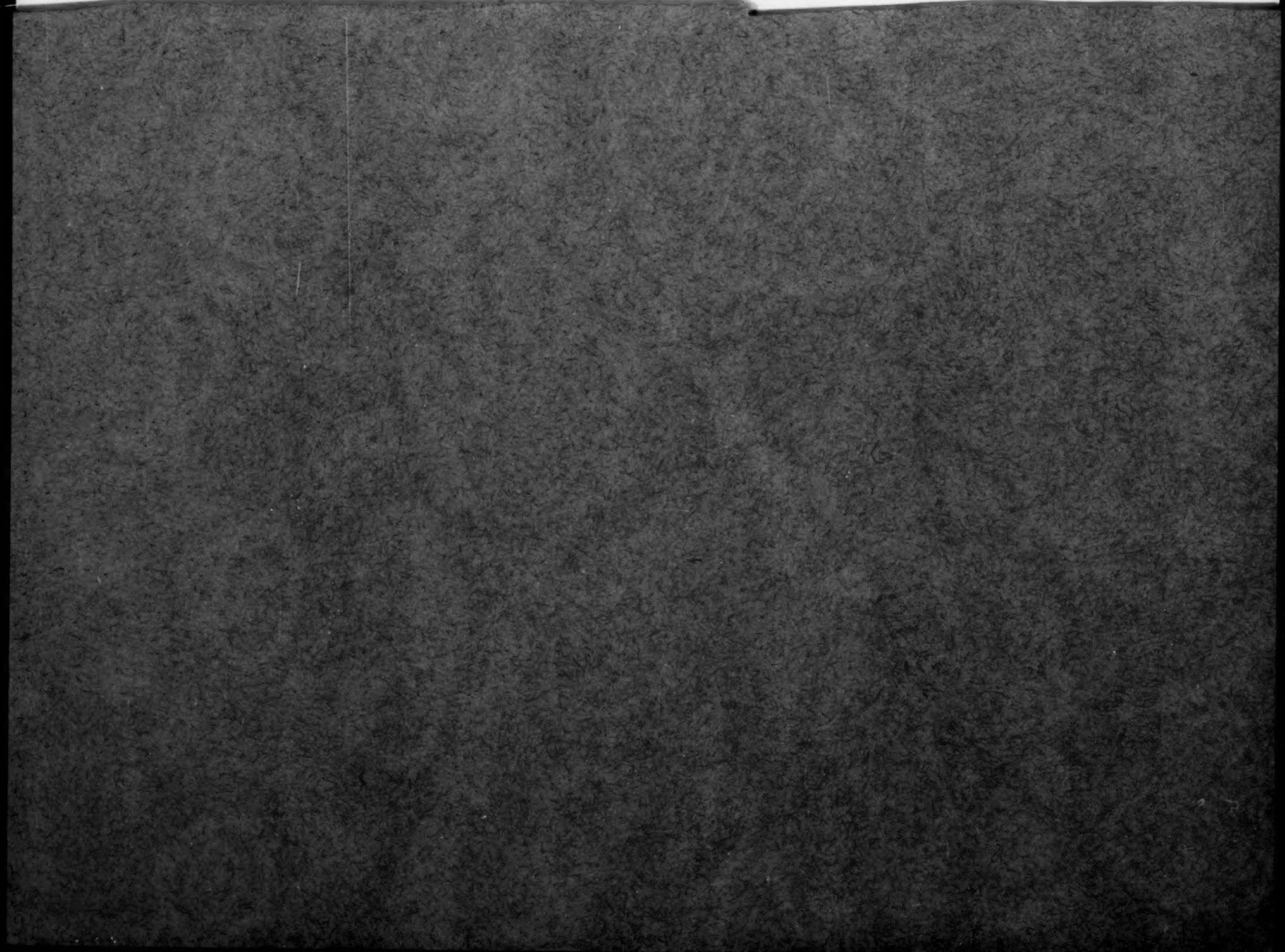
Fifth Annual
NORTH CENTRAL
WEED CONTROL CONFERENCE
RESEARCH REPORT

1948

SPRINGFIELD, ILLINOIS
DEC. 8-9-10



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FOREWORD

This Fifth Annual Research Report covers abstracts of individual investigations and summaries of projects, or investigations, undertaken in 1948 by cooperators in "Plans of Coordinated Projects of Weed Control Research" of the North Central Weed Control Conference. This report is to be considered as an appendix to the published proceedings of the 1948 Conference. The "Plans of Coordinated Projects" and this report have been prepared by the research committee of the NCWCC. Names of members of this committee are presented on the preceding page.

Plans of projects were revised in 1948 to keep our investigations in line with modern developments in weed control research and application in field use. Outlines of projects were expanded to encourage investigation of more and various factors in an attempt to broaden the base of data on which the special uses of herbicides are developed. Project plans were designed, however, to permit of summarizing data or reports of various investigators on a regional basis as in preceding years.

Approximately 150 copies of the "Plans of Coordinated Projects of Weed Control Research" were distributed. While most of these were sent to workers in the North Central Conference region, on request--copies were sent to practically every state and Canadian province and to several foreign countries. In addition a special investigation outline concerned with use of herbicides for control of weeds in sugar beets was sent to 24 investigators--mostly outside of the North Central region, as a supplement to PROJECT V. A special outline of a uniform investigation to determine varietal differences in response of fall planted cereal grains was distributed to twenty investigators in the fall planted grain area as a supplement to PROJECT III.

The research committee has attempted to be of active assistance to weed control investigators in the Conference throughout the season and has maintained contact with most of the individual contributors and their work through correspondence, aid in securing test herbicides and through the medium of two general news letters. The latter; sent to all research contributors, reported progress of investigations, new developments and personnel items of interest to the research group.

The research committee has, this year, assumed the additional responsibility and labor of assembling and publishing our own report. This was done in order to bring this report to the Conference membership at the time of the 1948 meeting rather than at the later date when the Conference proceedings are available. We have accomplished this only through the complete cooperation and acceptance of additional responsibility by each and every committee member. Project, or investigation leaders are in particular, to be complimented for the exact thoroughness with which they accomplished their large share of the publication burden. Individual contributors of abstracts are likewise to be complimented for their accomplishments in the field and laboratory as well as for the unselfish and wholly cooperative spirit that is entailed in the abstracted reports herein. This spirit, as embodied in the research committee of the NCWCC, has been a primary force in the lusty development of modern weed control research and practices.

In this report abstracts of individual investigations under each PROJECT are grouped in consecutive numerical order (numbered at left of abstract title.)

Abstracts of each PROJECT, and Investigations under PROJECTS, are preceded by a regional summary of all reported data prepared by the respective PROJECT or Investigation leader. Abstracts and summaries of all investigations under each PROJECT are indexed in sections designated by Roman numerals corresponding to the original PROJECT outline designation. (Roman numerals I through IX at top center of page.) Due to limited facilities and time, it was necessary to mimeograph this report in sections--hence impossible to use consecutive page numbers which would have simplified indexing. The use of abstract numbers under each PROJECT section was the only alternative which would permit ready cross reference indexing.

In addition to the PROJECT or "section" table of contents, we have included an author index; indicating contributions under section and abstract number. Note also that a mailing list of all contributors is included as an appendix to this report so that contributors may be contacted if information on specific investigations in addition to the abstracted report is desired.

Tabular summaries of data supporting abstracts included in this report, are being mimeographed separately and distributed only to research contributors. The tabular summaries of data are not to be reproduced in any way or considered as published material without specific consent of the contributors. Research contributors receiving tabular summaries are to consider this material as an appendix to the Research Report.

L. M. Stahler, Chairman Research Committee

TABLE OF CONTENTS

	Section	Abstract No.
PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS.	I	
Perennial Sowthistle		
Regional summary	I	Preceding 1.
Abstracts	I	1 - 6
Leafy Spurge		
Regional summary	I	Preceding 7.
Abstracts	I	7 - 13
Field Bindweed		
Regional summary	I	Preceding 14.
Abstracts	I	14 - 26
Canada Thistle		
Regional summary	I	Preceding 27.
Abstracts	I	27 - 43
Hoarycress		
Regional summary	I	Preceding 44.
Abstracts	I	44 - 49
Miscellaneous Species		
Regional summary	I	Following 49.
Check test of reactions to 2,4-D	I	Following 49.
PROJECT II USE OF HERBICIDES IN CONTROL OF ANNUAL WEEDS.	II	
Regional summary	II	Preceding 1.
Abstracts		1 - 5
PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDES IN GROWING CROPS.	III	
Controlling Weeds in Legumes Seeded with Cereal Crops.		
Regional summary	III	Preceding 1.
Abstracts	III	1 - 6
In Spring Planted Wheat, Oats, Barley.		
Regional summary	III	Preceding 7.
Abstracts	III	7 - 33
In Flax.		
Regional summary	III	Preceding 34.
Abstracts	III	34 - 48
In Fall Planted Wheat, Oats, Barley.		
Regional summary	III	Preceding 50.
Abstracts	III	50 - 59
In Corn and Sorghum		
Regional summary	III	Preceding 60.
Abstracts	III	60 - 80
In Perennial Grasses		
Regional summary	III	Preceding 81.
Abstracts	III	81 - 90

		Section	Abstract No.
PROJECT IV	PRE-EMERGENCE TREATMENTS WITH 2,4-D AND OTHER HERBICIDES TO CONTROL WEEDS IN FIELD CROPS.	IV	
	In Corn.		
	Regional summary	IV	Preceding 1.
	Abstracts	IV	1 - 16
	In Wheat, Oats, Barley, Rye, Sorghum, Soybeans. (See also Section V, abstracts 29-39)		
	Regional summary	IV	Preceding 17.
	Abstracts	IV	17 - 48
PROJECT V	INVESTIGATIONS OF WEED CONTROL METHODS IN HORTICULTURAL, TRUCK & MISC. CROPS.	V	
	Asparagus, Beans, Carrots, Sweet Corn, Onions, Strawberries, Fruits.		
	Regional summary	V	Preceding 1.
	Abstracts	V	1 - 28
	Beans, Peas, Clovers, Chemurgic Crops.		
	Regional summary	V	Preceding 29.
	Abstracts	V	29 - 39
	Sugar Beets		
	Regional summary	V	Preceding 40.
	Abstracts	V	40 - 43
	Potatoes		
	Regional summary	V	Preceding 44.
	Abstracts	V	44 - 51
PROJECT VI	INVESTIGATION OF METHODS OF CONTROL OF UNDESIRABLE WOODY PLANTS.	VI	
	Regional summary	VI	Preceding 1.
	Abstracts	VI	1 - 37
	Check list of species reaction to 2,4-D.	VI	Following 37.
	Check list of species reaction to 2,4,5-T.	VI	Following above.
	Check list of species reaction to a mixture of 2,4-D and 2,4,5-T.	VI	Following above.
PROJECT VII	INVESTIGATIONS TO DEVELOP NEW HERBICIDES AND APPLICATIONS OF NEW HERBICIDES TO WEED CONTROL.	VII	
	Regional summary	VII	Preceding 1.
	Abstracts	VII	1 - 36
PROJECT VIII	INVESTIGATION OF PHYSIOLOGICAL & CHEMICAL FACTORS IN WEED CONTROL.	VIII	
	Regional summary	VIII	Preceding 1.
	Abstracts	VIII	1 - 18

Mailing list of contributors. Appendix

INDEX OF CONTRIBUTORS

S - Summary as project leader.
* - Roman numerals refer to projects or sections, arabic to abstracts.

Alban, E. K. - V-1, 2, 3, 6, 16, 48.
Aldrich, Richard J. - IV-9.
Anderson, E. T. - V-7, 8, 37, 41, 50.
Atkind, M. D. - III-83.
Bakke, A. L. - I-S., 36; V-9; III-34.
Ball, H. L. - V-22.
Barrons, Keith C. - VIII-1; VI-19; VII-15, 20, 24, 25; V-38.
Bisal, F. - I-7, 44.
Bohmont, Dale - I-1, 43, 45; III-20, 24.
Bordeleau, R. - IV-10.
Bourns, J. J. - I-4, 13, 23, 33; III-26; IV-47, 6; VII-1, 26.
Bowser, Curtis W. - VI-37.
Breaky, W. J. - VI-2, 5.
Brooks, James S. - III-67.
Brown, Dr. Clair - VIII-14.
Brown, D. A. - I-8, 27, 46; IV-46; II-4.
Bruner, H. E. - IV-8; V-44, 18, 40, 45.
Buchholtz, K. P. - I-42; II-2; III-1, 6, 60, 61; IV-13, S; VII-27, 28, 29, 30, 31.
Buckley, G. F. H. - III-62.
Busdicker, H. B. - VI-23.
Carder, A. C. - I-28, 47; III-35, 58, 90; IV-18; V-5, 19.
Carlson, Robert F. - V-23.
Chubb, W. O. - I-5.
Coiteux, F. - IV-10.
Corns, W. G. - I-6; III-36; VII-5.
Coulter, L. L. - V-24, 28, 38; VI-20, 19; VII-25, 14, 20, 23, 24.
Coupland, R. T. - I-10.
Cox, Maurice B. - VI-25, 26.
Davidson, J. H. - VI-16, 17, 18; V-20, 24; VII-14, 22; III-37, 31.
Davies, Frank - III-80.
Day, Maurice W. - VI-22.
Derscheid, Lyle A. - I-2, 39, 40, 41, S., 19, 20, 21, 26; III-38, 19, 47, 11; IV-4, 38; V-32; VII-16, 17, 18; III-S.
Dieter, C. E. - V-28; VII-23, 19.
Dunham, R. S. - III-S., 39, 40, 41.
Dutton, W. C. - VII-S.
Elder, W. C. - I-24; III-80, S., 52, 53, 67; IV-3, 37; VII-7.
Elwell, Harry M. - VI-25.
Ficht, J. - III-30, 42.
Fischer, C. E. - VI-27, 28, 29, 30; VIII-13.
Friesen, H. A. - I-3, 29, 48; III-43, 29; IV-17; VI-15.
Fuelleman, R. F. - I-12, 22, 34; III-63, 64, 65, 3, 59, 68, 9, 76; IV-S., 1, 16, 2, 12, 43; V-35, 36; VII-10.
Grigsby, B. H. - V-S.
Hagood, E. S. - VIII-14.
Hall, W. E. - IV-8; V-18, 40, 45; VII-21.

Hamilton, Roger D. - VIII-2; IV-45.
Heggeness, H. - I-9.
Helgeson, E. A. - V-S., 33, 51, 42, 43; III-22, 23.
Helson, V. A. - VIII-17.
Hernandez, T. P. - III-66; V-10, 26, 27, 49; VIII-3, 4.
Hoffman, Otto, L. - VIII-8.
Holdeman, D. L. - VIII-14.
Holden, Charles, - III-67.
Hullinger, Clifford, H. - VIII-5.
Jensen, Raymond A. - VI-8.
Jugenheimer, R. W. - III-68
Klingman, Dayton L. - III-57, 87, 89; VI-1.
Knowles, George - I-S.
Koehler, James, VI-36.
Koski, Sulo O. - V-25.
Kramer, N. W. - III-69, 70; VIII-6.
Kratochvil, D. E. - I-2, 38, 39, 40, 41; III-19, 38, 11; IV-4, 38, 32; VII-16, 17, 18.
Larson, A. H. - II-S.
Lee, Oliver C. - III-74, 73, 72, 71, S; IV-5, 6, 7.
Leefe, J. S. - III-5.
Leggett, H. W. - I-30; III-21.
Leng, E. R. - VIII-7.
Linder, Paul J. - VIII-9.
Lodmis, W. E. - VIII-11.
Lungren, E. A. - VI-24.
MacDonald, Wm. P. - IV-19, 20, 21, 22, 25, 26, 27, 28, 30, 31, 32, 33, 39, 40.
MacKay, E. M. - I-5.
McCall, George - I-25; III-75; IV-15; VII-6, 9, 12; VI-21.
McCombs, Leslie, - V-1, 2, 6, 16, 48.
McDermond, John - III-82, 84, 86.
McIlvain, E. H. - VI-7.
McKibben, G. E. - III-59, 76; IV-2, 12.
McNew, George, - VIII-S., 8.
Mantell, A. B. - V-7, 8, 37, 41, 50; VIII-15.
Marion, P. T. - VI-27.
Melander, L. W. - VI-S., 23, 24.
Miller, John H. - I-9, 35; III-S., 4.
Mitchell, H. L. - VIII-2.
Mitchell, John W. - VIII-9.
Moss, V. D. - VI-31.
Moulton, J. E. - V-23.
Mullison, Wendell, R. - V-38; VII-20; VIII-10.
Nylund, R. - V-11, 17, 21.
Offord, H. R. - VI-31, 32.
Olson, P. J. - III-32, 49; IV-11, 44.
Owen, C. W. - V-29.
Paddock, C. F. - VIII-6.
Pavlychenko, T. K. - I-S., 10, 31, 32; III-28, 27, 45, 44; IV-23, 29. 34, 35, 44; V-46.
Peterson, Clinton, E. - V-15.
Phillips, Wm. - I-16, 17, 18; II-5; III-56, 55, 54; VII-8.
Playfair, L. - VI-6.
Robinson, R. G. - III-39, 40, 41.

Roe, Foster, J. - III-25.
Saboe, Lewis, C. - IV-42.
Sackston, W. E. - III-46.
Sand, Paul, - V-39; VII-33.
Savage, D. A. - VI-7.
Scott, W. O. - I-12.
Sexsmith, J. J. - I-11; III-33.
Shafer, Neal E. - III-77; IV-48; V-39; VII-32, 33.
Shaw, Warren C. - III-50; I-37; IV-36, 9, 42, 24; V-31; VII-11, 13.
Slife, Fred - I-12, 34, 22; II-3; III-3, 81, 63, 64, 65, 68, 9; IV-43, 1, 16; V-22, 30, 35, 36; VI-3, 4; VII-2, 10; VIII-7.
Slough, A. T. - IV-19, 20, 21, 22, 25, 26, 27, 28, 30, 31, 32, 33, 39, 40.
Smith, Webster, - V-3, 16.
Stahler, L. M. - I-2, 19, 20, 21, 26, 40, 41; III-47, 19, 11; IV-38; V-42, 43; VII-3, 4, 19, 16.
Staniforth, D. W. - III-34; VIII-11.
Stoeckeler, J. H. - VI-14, 33, 34.
Stuckey, H. E. - VI-35.
Swanson, Charles, R. - V-51, 33, 43, 42; VIII-12.
Swingle, Homer, - V-1, 2, 6, 16, 48.
Taylor, D. K. - III-2, 48.
VanFossen, J. E. - V-34.
Viehmeyer, Glenn - III-S., 88, 86, 84, 82, 78, 79; V-47; VI-9.
Warren, G. F. - V-4, 12, 13, 14; VII-34, 35, 36.
Watson, W. M. - VI-24.
Webb, J. - IV-2.
Weigland, Len, - II-1.
Willard, C. J. - I-37; III-50, 69, 70, 7, 8; IV-36, 9, 24; V-31, 40; VII-11, 13.
Wilson, Clyde - V-40.
Wilson, J. D. - V-18, 45; VII-21.
Woestemeyer, Vernon - I-14, 15; III-51; VI-35.
Wolfe, Henry - III-77; IV-48.
Wolfe, Laird, G. - III-85.
Wood, H. E. - I-S., 4, 13, 33, 23; III-26; IV-47; VI-5, 6; VII-1, 26.
Young, Dale W. - VIII-13.
Young, H. C. - V-40.
Zahnley, J. W. - I-S., 49, 25; III-75; IV-45, 15; VI-21; VII-6, 9, 12; VIII-..
Zalik, Saul - III-32, 49; IV-11, 44.
Zehngraff, P. F. - VI-10, 11, 12.
Zinter, Clinton - IV-19, 20, 21, 22, 25, 26, 27, 28, 30, 31, 32, 33, 39, 40.

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS

Perennial Sow Thistle (Sonchus arvensis) Investigation leader: H.E. Wood

Dosages around 1½ pounds acid of 2,4-D per acre when applied to perennial sow thistle in the bud-flower stage has given, under most trials, a considerable measure of eradication. Application to thistles in growing crops usually in the pre-bud to early bud stage of from ¼ to ½ pounds acid per acre is giving a measure of control to a point where the weed seldom produces seed and is of little trouble at harvest time.

For eradication less than one pound acid per acre is unsatisfactory, whereas rates as high as three pounds gave little if any better results than 1½ pounds. While the esters acted more rapidly, the final results of all three formulations were much the same, the esters and amines giving rather better results perhaps than sodium salt. Repeat applications would seem necessary for complete eradication. Eradication is hastened when the weed is in active competition with an aggressive grass.

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS

Abstracts of Results of Individual Cooperators.

Perennial Sow Thistle

1 Use of 2,4-D in control of perennial sow thistle (Sonchus arvensis L.). Bohmont, Dale W. Replicated rod square plots were sprayed with ¼, ¾, and 1¼, and 2 pounds of the butyl ester, alkinolamine and sodium salt of 2,4-D. All material was applied at the rate of 40 gallons per acre. Quadrat counts were taken after spraying in July 1947, and survival counts were taken again in July 1948. All treatments reduced the survival count compared to the untreated check. The ¼ pound concentration was the least effective treatment in all three formulations. The most effective treatment was the 2 pounds amine which had a significant survival count of 2.3%. This compares favorably with 30.8% survival for 2 pounds ester and 21.6% survival for the 2 pounds salt treatment. The 1¼ pounds amine were also effective; had a lower survival than either the same or heavier concentrations of the ester or salt treatments. (Contribution of the University of Wyoming, College of Agriculture and Experiment Station.)

2 The effect of treating and retreating perennial sow thistle (Sonchus arvensis L.) with three formulations of 2,4-D at three rates of application. Derscheid, Lyle A., L. M. Stahler and D. E. Kratochvil. Square rod plots of perennial sow thistle were treated in duplicate with the butyl ester, triethanol amine salt and monohydrate sodium salt of 2,4-D at the rates of ¼, ¾, and 1¼ pounds of 2,4-D acid per acre. The original application was made July 9, 1947, when the thistles were 75% in bud. The weather was very dry. Identical retreatments were made September 8, 1947, on the fall rosettes. Live plant counts were made September 8, 1947, and June 8, 1948. The per cent of eliminated plants was based on a comparison of treated and untreated counts. The ester showed a decided advantage over the other two formulations when the first count was made. This may have been due to the adverse conditions present at the time of treatment or it may have been due to the faster action of the esters. After two treatments, the ester appeared to be slightly more effective at the ¼ pound rate with 84% control as compared to 78.7% for the amine and 68% for the sodium salt. There appeared to be little difference in formulations, after two treatments, when ¾ or 1¼ pounds of 2,4-D acid were used as there was a range of 91.5% elimination for ¾ pounds of amine to 98.1% reduction in stand when ¾ pounds of the ester were used. (Contribution of the Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A.)

3 Effect of 2,4-D in the control of perennial sow thistle (Sonchus arvensis L.) Friesen, H. A. During 1948 various formulations of 2,4-D were applied to perennial sow thistle at dosages of ½, ¾, 1, 2, and 3 pounds acid equivalent per acre. The treatments were made at four stages of growth, viz; (1) spring rosette (2) first bud (3) full bloom, and (4) fall rosette. Treatments made during the first three stages of growth resulted in complete killing of the top growth at all dosages of the ester formulation used. The amine and sodium salt formulation were 30 and 40% less effective when comparable dosages were used. Treatments in the fall rosette stage did not appear to be very effective. Root kills in 1948 were disappointing, except where the ester was used at rates in excess of one pound acid per acre. Plots treated with the ester at the first bud stage at rates of 1, 2, and 3 pounds per acre showed only 35, 15, and 15% regrowth by October 1. Treatments with

the ester at the other growth stages or with the amine and sodium salt formulations at all growth states were as much as 40% less effective. In 1946 and 1947 root kills were much higher, particularly where the ester was used at rates of 1 pound or higher per acre during the first bud and bloom stages. Root kills observed in those two seasons were as high as 90 to 95%. Sow thistle treated in the spring rosette stage resulted in only 40% root kills even at the high rates of the ester. The amine and sodium salt formulations in 1946-1947 were less effective than was the ester type. (Contribution of the Dominion Experimental Station, Scott, Saskatchewan, Canada.)

4 Eradicating perennial sow thistle (Sonchus arvensis L.) with 2,4-D. Wood, H. E., and J. J. Bourns. Further trials and field observations confirm earlier findings to the effect that this weed when treated in the bud to early flowering stage can be largely, if not completely, eradicated with one spraying. Best results were obtained by spraying with two rather than one pounds acid per acre; an amine (triethanolamine) gave comparable results with several forms of esters (isopropyl, butyl, methyl and amyl), whereas sodium salt proved rather less satisfactory. Treatment a month earlier while plants were in the rosette stage gave disappointing results. Root examination of large plots, machine sprayed July 1948, confirm above results drawn mainly from plots laid down in 1947. Excellent control of sow thistle was observed in a number of grain fields treated during 1948 at the maximum dosage recommended for the particular crop (usually from 4 to 8 ounces acid per acre). While often not killed, the plants were found in very "stunted" condition, and seldom produced a flower stem. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada.)

5 2,4-D used to control perennial sow thistle in barley. Chubb, W. O., and E. M. MacKey. In mid-June 1948, at Portage la Prairie, a series of plots in a field of barley infested with sow thistle was machine sprayed with amine (alkanolamine) at ½ pound acid per acre, the day being cloudy and moist with some rain soon after treatment. Two days later additional plots were treated as above; also with ester (isopropyl) at ¼ pound acid per acre, the weather bright and clear; temperature both days about 71° F. Twelve days later the best weed kill was noted on the ester treated plot; the poorest on the amine plot treated the cloudy day. Twenty-two days after treatment the sow thistle was severely affected on the ester plot with rather less satisfactory control on the two amine plots, especially the first treated where rain followed soon after spraying. (Contribution of Dominion Department of Agriculture, Pilot Flax Mill, Portage la Prairie, Manitoba, Canada.)

6 Effect of foliage sprays with ester and amine formulations of 2,4-D acid on intact and severed perennial sow thistle plants (Sonchus arvensis L.) Corns, W. G. The author's results of plant-injection experiments during 1947 indicated that downward translocation of 2,4-D from stems of topped sow thistle plants is much more extensive than that occurring in intact plants after treatment of their inflorescences with a corresponding amount of 2,4-D. (Can.J.Res. Sec.C, June 1948). In 1948, foliage sprays were tested on similar material. Rows of S. arvensis were field grown from 2 inch portions of one year old roots. At early flowering (mid-July) half the material was topped 10 inches above ground and then sprayed with triethanolamine and butyl ester at 1 and 1½ pounds 2,4-D acid per acre (both groups). In all cases ester treatments showed striking superiority in rapidity of kill of top growth, penetration of root system, and in limitation of amount regrowth. Damage to root system was consistently greater for topped plants (either formulation). (Contribution of Department of Plant Science, University of Alberta, Edmonton, Canada.)

6-a Effect of various systemic (hormone) herbicides on perennial Sow thistle (Sonchus arvensis) at the bloom stage. Pavlychenke, Thomas K. Forty plots 16 x 100 foot in size, infested with perennial sow thistle were treated at the late bloom stage, July 23rd, with Weedone concentrate 48, Weedone No. 5, (ethy esters, 2,4-D) LFN549 (ester, 2,4,5-T) and with various combinations of the three esters at 8, 16, 24 and 32 ounces of acid equivalent per acre. In addition, 40 and 48 oz/a rates of LFN549 were applied. Results: the records taken 75 days after treatments indicated that the top growth was 100 pct. killed by both Weedone concentrate 48 and Weedone No. 5 esters, but some pale-greenish leaves were still present in the lower rates of LFN549. Very extensive root damage was apparent in the plot treated with both esters of 2,4-D, but was much less pronounced in the LFN549 plots. The re-growth was virtually absent in the uncut plots and only from 1 to 6 pct. of new shoots were observed, particularly in lower spots, of the cut plots. The top growth of the wild Rose bush was 100 pct. killed by LFN549, but was uneffected by other chemicals. (Contribution of Agr. Field Res., American Chemical Paint Co., Ambler, Pennsylvania.)

I

USE OF 2,4-D AND 2,4,5-T IN CONTROLLING LEAFY SPURGE (EUPHORBIA ESULA)

REGIONAL SUMMARY

By: Thomas K. Pavlychenko[x]

Five reports from the three Western provinces of Canada, Manitoba, Saskatchewan and Alberta, and two reports from the central area of the United States, Minnesota and Illinois were offered for this summary. The majority of plots at all points were treated with 2,4-D preparations. In 1948 most workers also reported some results from the treatments with 2,4,5-trichlorophenoxyacetic acid.

Most of the available forms of 2,4-D, esters, amine and sodium salts were applied at rates ranging from ½ to 4 pounds of acid equivalent per acre. The 2,4,5-T was used alone and in combinations with 2,4-D approximately at the same rates. These chemicals were used mostly in water, but the oil carriers were also tried. The treatments were made at all the typical stages from an early spring to the late fall. Some workers had plots on the grass soded sites; on undisturbed but grass-free land, and on land previously cultivated and then infested with the weed. In addition one worker reported results from the treatments of this weed in a growing crop.

The predominant tone of all the reports is that leafy spurge is a difficult plant to eradicate. All the workers reported that the top growth was easily destroyed and the weed prevented from producing seed by all treatments at rates of 1 or more pounds per acre irrespective of the formulations used. The regrowth was observed in all cases. This frequently amounted to practically 100 per cent of the original stand after the first and sometime even after two treatments in May and June, but the July and August treatments mostly resulted in reduction of the original stand from 50 per cent or more. Those who worked with infestations on the grass soded areas and on grass-free sites are well in agreement that the presence of even weak stand of grass helped the chemicals through a rapid occupation of the treated plots. Repeated applications at lower rates seemed to be more effective than single applications at much higher dosages. One worker reported that the cultivation of the infested area prior to treatments had materially helped to drastically reduce the stand of leafy spurge. Another investigator found that a single treatment of the young weeds in a growing crop with as little as 4 oz/a rate had seriously stunted the weeds and totally prevented them from going to seed. All reports state that the 2,4,5-T does not offer any additional advantage over the 2,4-D formulations and sometimes seemed to be weaker from them.

In general, it may be stated from the reports reviewed, that in spite of the strong resistance that leafy spurge had shown toward the 2,4-D and 2,4,5-T chemicals, the prospects for effective control are good and under certain circumstances the possibility of eradication by repeated treatments may not be excluded.

x Director of Field Research, American Chemical Paint Company. Ambler, Pa.

Considering the up to date results and the circumstances under which they were secured it seems advisable in the future tests and particularly large scale eradication work to pay full attention to the following points:

(1) cultivation and seeding down to the grass best adapted to the regional climate and soil, prior to treatments.
(2) repeated treatments at lower rates sufficient to keep the top growth almost permanently down during the growing season.
(3) treatments of the young weeds in a growing crop to prevent the weeds from going to seed and from severe competition with the crops.

ABSTRACTS

7 Treatments of leafy spurge with 2,4-D and 2,4,5-T formulations. F. Bisal, On August 29, 1947, one square rod plots of leafy spurge had been treated with 2,4-D(ester) at the rate of 2 lbs. of acid in 4 gallons of water per acre. On July 16, 1948, there was still a 50% reduction in stand. All work carried out this year with 2,4-D and Trichlorophenoxyacetic acid has not given better results than previously; there has always been a kill of top growth but regrowth has been 100% with the one exception. A mixture of Trichloroacetic acid and ammonium hydroxide made up to a pH of 7.5 gave a kill of top growth with no more effect on the roots than 2,4-D. One plot of leafy spurge was treated with a mixture of 1 lb. of 2,4-D(ester) and 3/4 lb. of sodium carbonate. This was applied at the rate of 2 lb. of acid equivalent in 4 gallons of water per acre. The leafy spurge was treated on July 16, 1948, and checked on October 13, 1948. All buds on the roots at least to a depth of 6" depth, were dead and decaying. The buds on the roots of the plots treated with 2,4-D and Trichlorophenoxyacetic acid were in a healthy stage of growth. On the plots treated with 2,4-D young plants are growing, which are now 3-4" in height. In the plot treated with the mixture, there are no young plants and the crested wheat grass has had less competition and has grown very well. The plots and field had been seeded to crested wheat grass several years past. (Contribution of Experimental Station, Swift Current, Sask.)

8 Leafy spurge eradication with 2,4-D. Brown, D.A. Plots of leafy spurge were treated with ester, amine and sodium salts of 2,4-D, at rates of 2 and 3 pounds of acid equivalent per acre. In one series the treatments were made only once after full emergence on May 21st, 1947 with 1 and 2 lbs/a rates: another series on June 6 in pre-bud stage; the third series on August 23, in bloom; the fourth series on September 26, in fall rosette stage and the fifth was treated repeatedly, in June, August and September. In 1948 all treatments were made with 2,4-D ester only. In one series at the rate of 3 lbs./a on June 16: in another series treated on the same day and in the thirds series treated on July 29, the soil was dug before the treatments; in the fourth series the rates were lowered to $\frac{1}{2}$ lb/a and applied repeatedly, on June 16, and July 29. Results: the two years work with leafy spurge by Brandon Farm at Melita, Manitoba, shows definitely that single sprayings of 2,4-D, up to three pounds acid per acre, at the very best killed an average of less than fifty per cent of the plants, but repeated treatments (two or three times) even as low as $\frac{1}{2}$ pound of acid per acre gave very effective control. (Contribution of Experimental Farm, Brandon, Manitoba)

9 Response of leafy spurge (Euphorbia esula) to herbicides. Miller, John H., Heggeness, H. G. In 1948 leafy spurge was treated with 1, 2, and 3 pounds of acid per acre of 2,4,5-T and 2,4-D in 40 gallons of water at the spring rosette (plants 6-8" tall), bud, and full bloom stages. Quadrats had been laid out in these plots and counts of leafy spurge shoots made. Although it is felt that the data so far collected, are inconclusive and that conclusions should not be drawn for at least another year or two, the following trends are indicated. With the triethanolamine and isopropyl ester of 2,4-D, applied before flowering at concentrations of 2 and 3 pounds of acid per acre, observations based on fall counts indicate decreased stands of leafy spurge. In general, the surviving plants displayed decreased vigor. Also based on fall counts, the plots treated with isopropyl ester in fuel oil applied before flowering at the rate of 1 pound per acre appeared most promising. Of the 2,4,5-T treatments, a mixture comprised of the 2,4,5-T stock solution diluted with fuel oil applied at the rates of 1 and 3 pounds of acid per acre were most promising, however these plots did not appear as satisfactory as the isopropyl ester of 2,4-D in oil. All applications were effective in killing back the top growth of leafy spurge and in controlling annual broadleafed weeds with the exception of wild buckwheat. Heavy stands of yellow foxtail (Setaria leutescens) were evident in most treated plots whereas it was absent in all untreated plots. The reason for this infestation of foxtail is not clear at this time. (Contribution of U.S.I.A., Bureau of Plant Industry and Division of Pathology and Agricultural Botany, University of Minnesota.)

10 Effect of 2,4-D and 2,4,5-T treatments on leafy spurge. Pavlychenko, Thomas K., and Coupland, R. T. From 1945 until 1948 leafy spurge was treated with various 2,4-D formulations: (1) in crested wheat grass and native grass sods; (2) on virgin land free of grasses but thoroughly infested with leafy spurge, and (3) on cultivated land infested with leafy spurge. In 1948, 2,4,5-T alone and in combinations with 2,4-D was also used. The treatments were made in late spring rosette, bloom and fall rosette stages. Rates from 1 to 3 pounds of acid per acre in forms of esters and amine and sodium salts were used. This work has definitely indicated that the weed could be much easier controlled and frequently eradicated by repeated treatments in grass sods than on virgin land free of grasses. The old stands of the weed showed much greater resistance to chemicals than newly established infestations on cultivated soil. The treatments in the bloom stage were more effective with all the chemicals and rates than at any time prior to the bloom stage. Repeated treatments under these habitats were more effective than single treatments even at higher rates. 2,4-D seemed to be somewhat more effective than 2,4,5-T. Only in a few cases was eradication secured in one season with ester treatments in July at 1½ and 2 pound rates on the grass soded areas. The top growth was effectively killed in all plots and a substantial reduction in stand was recorded in July and September treatments, but all treatments in May and June resulted in nearly 100 per cent regrowth. Surface cultivation of the infested areas, followed by seeding to proper grasses prior to treatments, seems to offer considerable assistance to the effectiveness of the chemicals on leafy spurge. (Contribution of the Research Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Sask.)

11 Use of 2,4-D in control of leafy spurge. Sexsmith J.J. Triethanol amine and butyl ester 2,4-D were applied to leafy spurge in early bloom on June 17, 1947, at rates of ½, 1, 1½ and 2 lbs. of acid per acre. Seed formation was prevented by all treatments, but top growth kills were complete for the 1½ and 2 lb. rates only. All plots were retreated on August 29, 1947, at the same rates as original treatments. At this date the regrowth shoots were 3-5 inches tall. All regrowth shoots were effectively killed and no seed was produced during the remainder of 1947. No reduction in stand was evident on examination in the spring of 1948. Plots were treated again on June 19, 1948, at the same rates as used in 1947. The spurge reacted as it had in 1947 in that seed formation was prevented by all treatments, and complete top growth kills resulted only from the 1½ and 2 lb. treatments. At the end of the 1948 season there was no noticeable reduction of leafy spurge infestation resulting from any treatment. An area of approximately 30 acres of leafy spurge was dusted on June 19, 1948, using a 5% ester dust at rates of 7 and 9 pounds per acre. Such treatments supplied 5.6 and 7.2 ounces of acid per acre. Neither rate completely prevented seed formation or completely killed top growth. Results, to date, indicate that 2,4-D may be useful for control of leafy suprge, but that 2,4-D is of little value for eradication of extensive infestations under conditions existing in the southern part of Alberta. (Contribution of Dom. Dept. Agr., Exp. Sta., Lethbridge, Alberta)

12 Control of leafy spurge with 2,4-D and 2,4,5-T. Slife, F. W., R. F. Fuelleman, and W. O. Scott. During 1948, 85 plots of leafy spurge (Euphorbia esula) were treated with 2,4-D and 2,4,5-T. Concentrations of ½, 2, and 4 pounds of acid in the forms of ester, amine salt, and 2,4,5-T were used. Single applications in May were effective in killing top growth, but regrowth two months later showed no appreciable reduction in stand. Two applications; one in May, the second in July, were effective in reducing the stand on some plots but examination of root systems showed little injury below a depth of six inches. Plots located in areas where spurge had been prevented from spreading by good cultural practices showed it to be in a weaker condition and more susceptible to 2,4-D. 2,4,5-T does not seem to be any more effective than 2,4-D ester when applied at equal rates. Fall applications were made in September on new plots and examination of these in October showed no penetration of the chemical below ground level. (Contribution of Ill. Agr. Exp. Sta., Urbana, Ill.)

13 Leafy spurge eradication with 2,4-D and 2,4,5-T. Wood, H. E. and Bourns, J.J. Although extensive trials since 1945 with several formulations of 2,4-D at various rates, dates, and re-treatments on leafy spurge had given little encouragement, field trials on an acreage basis started in 1947, were continued and extended during 1948. In addition to 2,4-D, 2,4,5-T was used, both separately and mixed with 2,4-D. Acreage plots of heavily infested spurge on sandy loam soil treated in mid-July, 1947 (spurge 12-24 inches high and setting seed) were noted in early summer 1948 before re-treatment to be delayed in maturity and about 50% thinner in stand than untreated balance of field. Quack grass in competition with the treated spurge had gained headway. On 1948 plots, 2,4,5-T alone, or mixed with 2,4-D was less effective than the esters of 2,4-D. One series of plots treated with amine were comparable in results to those sprayed with ester. In spring wheat sparsely infested with spurge in flower, excellent control (spurge killed back to the ground) was obtained by as little as 4 ounces acid ester; the same amount 2,4,5-T gave less satisfactory control. (Contribution of the Weeds Commission, Manitoba Dept. of Agric., Winnipeg, Manitoba, Canada)

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS

Field Bindweed Investigation leader: Lyle A. Derscheid

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Thirteen abstracts, eight of which had supporting tabular data, were submitted by seven investigators or teams of investigators. A perusal of these data indicates that some rather definite conclusions can be drawn. Most of these conclusions are not new, but are useful in that they confirm the trends that were introduced previously.

One outstanding conclusion that can be drawn is that 2,4-D seldom eradicates field bindweed. All of the investigators indicate that 90-95% control is not uncommon, however. Woestemeyer was able to get complete elimination of bindweed plants on two plots that had been treated each of three consecutive years. He and Phillips, who also made treatments each of three years, indicate that retreatment will reduce the stand but that complete elimination is seldom attained.

Derscheid and Stahler indicate that retreatment of field bindweed one year after the original treatment is seldom necessary if the original application is applied when the weeds are growing vigorously. Phillips indicates that each retreatment reduces the stand, but Woestemeyer reports that retreatment on the second year may not affect the stand materially. The writer feels that field bindweed may not recover from the effects of 2,4-D for a year or more after treatment even though it is not killed. In this event rapid rate of growth is seldom attained and it is useless to retreat until the surviving weeds have recovered sufficiently well to regain vigorous growth.

The investigators are not in complete agreement as to the most susceptible stage of growth. Zahnley and McCall indicate that fall applications are more effective than earlier treatments. Elder also reports 10% more elimination from fall treatments than from those applied to the bud stage of growth, but he indicates this may have been due to better coverage. Wood and Bourns indicate that a two pound application was effective as a fall application in stubble, but that a ½ pound application was satisfactory when applied to the full bloom stage. Derscheid and Stahler indicate that fall treatments will cause this weed to appear dead until late the next spring, but that many plants may recover. Slife and Fuelleman indicate that 2,4-D works slower when applied in the fall and, therefore, may recover during the winter. Woestemeyer indicates that late bud applications are more effective than full bloom, but adds that this is probably due to difference in soil moisture content. Phillips, on the other hand, secured better results from applications made at first bloom and full bloom than from those applied earlier.

Although the southern states may expect to get better results from fall applications than the northern states, it appears that a high soil moisture content is strongly correlated with effective control, Woestemeyer, Derscheid and Stahler, Elder and Phillips all agree on this statement.

There is very little difference in the effectiveness of the various formulations. Derscheid and Stahler, Woestemeyer and Phillips each report one experiment in which the ester appeared to be most effective, but Phillips also reports an experiment where the amine is more effective and Zahnley and McCall, Wood and Bourns, Slife and Fuelleman, and Derscheid and Stahler each report that there is no difference is the effectiveness of the various formulations used. Elder states that ½ pound of ester is more effective than ½ pound of amine but that if 1 pound is used they are equal. Woestemeyer, and Derscheid and Stahler indicate that the ester is most effective if applied under adverse conditions but that the amount of control obtained is not satisfactory. Derscheid and Stahler indicate that sprays are in general, slightly more effective than dusts and that on one occasion the ammonium salt spray was less effective than the other sprays.

All investigators are agreed that less 2,4-D is needed to control field bindweed than was originally thought. Woestemeyer indicates that 3/4 pound of an ester or amine or 1 pound of a sodium salt are sufficient. Phillips reports that 1 pound is as effective as more and that in one case ½ pound of the ester was sufficient. Elder obtained good control with 1 pound while Derscheid and Stahler report a high degree of control with 2/3, 5/8 and 3/4 pound rates. Slife and Fuelleman report that good control appears to have been obtained in 1948 when 1/3 of a pound was used in corn, but that 3 pounds were ineffective on this weed in bluegrass. Zahnley and McCall report 96% control in grass with ½ and 3/4 pound rates, but only 5 to 15 per cent control with the same rates in corn.

Elder, Zahnley and McCall and Derscheid and Stahler give reports on the use of 2,4-D in conjuction with cultural methods of control. The data is limited but Elder reports good bindweed control in wheat, Zahnley and McCall report that better control was obtained when grass was seeded after the application of 2,4-D than when corn was planted. They also indicate that bindweed in corn is not satisfactorily control with 2,4-D. Derscheid and Stahler state that the control obtained by applying 2,4-D in oats is as satisfactory as using the chemical in conjunction with rye and fallow and that corn is relatively free of bindweed that was sprayed in oats the preceding year. This is a relatively new field that should be studied thoroughly to determine the most economical and practical use of 2,4-D from the standpoint of crops produced.

On the basis of these reports it appears that rate of growth is the most important single factor to consider. When good soil moisture conditions prevail ½ to 1 pound of 2,4-D acid per acre is sufficient, depending upon the locality. All formulations appear to be equally effective under good growing conditions and retreatments for two or more years are not necessary. Under adverse growing conditions more than 1 pound of 2,4-D is more effective than less, but it still does not give satisfactory control. Likewise, the ester is slightly more effective under adverse conditions, but does not give satisfactory control.

PROJECT I. USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS.

Abstracts of Results of Individual Cooperators.

Field Bindweed

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14 A comparison of the effectiveness of different commercial preparations of 2,4-D in eradicating field bindweed. Woestemeyer, V. W. Eight commercial preparations of 2,4-D, including three salts, two amines, two esters, and one acid were compared as sprays at the rate of two pounds of 2,4-D per acre on duplicate plots of field bindweed. Original applications were made May 27, 1946, on a uniform stand of bindweed in the rapid-growth bud stage. Retreatments were made at the same rate and stage June 11, 1947, and May 19, 1948. Regrowth was counted August 24,1946, September 26, 1947, and September 15, 1948. In 1946, an average of fifty plants per square rod, or 10.4% of the original stand, had emerged when the count was made. The esters and acids showed slightly better kills than the salt and amine types. There was little change in the 1947 count. The 1948 count showed a definite decrease in surviving plants on all plots, with no appreciable preference for any one type of 2,4-D. On one plot for each of the three types, amine, ester, and acid, bindweed has apparently been eradicated. This is the first year that any plot has indicated complete eradication. Although none of the plots sprayed with salts indicate complete eradication, the average count on these plots is the same as the average for all types at this time. There was sufficient moisture for rapid growth in 1946, excessive moisture in 1947, but the spring of 1948 was dry prior to spraying. (Contribution of Kansas Agricultural Experiment Station.)

15 Use of 2,4-D in controlling field bindweed. Woestemeyer, V. M. Duplicate square rod plots of bindweed were sprayed in 1948 with sodium salt, amine and ester types of 2,4-D at rates ranging from one-half to three pounds 2,4-D per acre. Applications were made in late bud (May 17) and full bloom (June 9) stages. Reductions of bindweed stand from bud stage spraying were small with the count on October 1 averaging approximately sixty per cent of the original. At this stage sodium salts showed best results at one pound per acre and up, and esters at three-fourths pound per acre. Amine results were more variable, with the three-fourths pound rate giving the greatest reduction. Full bloom spraying gave very unsatisfactory results, with the October 1 count showing an increase in stand on nearly all plots. Duckfooting twice in August when soil moisture was ample, to control grass on the plots may have increased the plant count some as both parts of cut plants may have continued to grow in some cases. The spring season was unusually dry. Bindweed had not made a vigorous growth at the bud stage, and was still less succulent at the bloom stage. In fact we considered omitting the latter spray treatment because of the poor growing conditions. (Contribution of Kansas Agricultural Experiment Station.)

16 The relation of stage of growth and rate of application to the effectiveness of 2,4-D in eradicating field bindweed. NCWCC Proj. I, 1948. Phillips, W. M. An ester at 1/2, 1, 1, 1/2 and 2 lbs. per acre and an amine at 1, 1 1/2, 2 and 3 lbs. per acre were applied on bindweed at complete emergence, first bloom, full bloom, and fall growth stages. Preliminary data indicate first bloom and full bloom applications gave more satisfactory kills than spraying at complete emergence. There appeared to be no definite advantage of one chemical over another; however, the amine consistently gave slightly better kills. In general the two higher rates gave more satisfactory results than the lower rates. The ester applied at first bloom and the amine at full bloom were exceptions. In no case was the 1/2 lb. of ester as effective as the higher rates. (Contributions of Bureau of Plant Industry, Soils, and Agricultural Engineering, Division of Cereal Crops and Diseases, Hays, Kansas.)

17 The relation of stage of growth and rate of application to the effectiveness of 2,4-D in eradicating field bindweed. NCWCC Univ. Exp. I - 2,1946. Phillips, W. M. The sodium and amine salts of 2,4-D were applied at 1, 2, 3, and 4 pounds of 2,4-D on bindweed at full emergence, bud, full bloom and fall growth stages in 1946. An ester was applied at these rates at bud and fall-growth stages. Treatments were repeated in 1947 and 1948 at corresponding stages of growth. The ester appeared to be more effective in thinning the stand with one application but seems to be little, if anymore, successful in giving complete eradication with repeated treatments. For the first two applications heavier rates of amine and sodium salt tended to cause greater reductions in bindweed; however. 1 lb. of ester was about as effective as higher rates. The 1948 retreatment failed to show any distinct advantage for any formulation and the lighter rates of all types appeared to be nearly equal to the heavier rates on the remaining plants. Results from the 1948 fall retreatment are not available but the fall applications appear promising when there is sufficient moisture in the soil. No great differences were noted in the spring dates of treatment. Eradication was not complete on all plots of any treatment. (Contibuted by Bureau of Plant Industry, Soils, and Agricultural Engineering, Division of Cereals Crops and Diseases, Hays, Kansas.)

18 The relation of stage of growth and rate of application to the effectiveness of 2,4-D in eradicating field bindweed. NCWCC Univ. Exp. 1-2, 1947. Phillips, W. M. An amine and sodium salt were applied at 1, 2, 3, and 4 lbs. 2,4-D per acre, and an ester at 1/2, 1, 2, and 3 lbs. on bindweed at complete emergence, first bud, and full bloom. Original applications were made in 1947 and retreatments were applied approximately one year later at corresponding stages of growth. Results from the original application showed no consistent trend for rate of application, nor any great differences between the types of 2,4-D. Retreatments also fail to indicate any definite trend as to rates of application. Complete emergence treatments with the ester and amine gave greater reduction in bindweed than other dates. The sodium salt was most effective when applied at the first bud stage. (Contribution of Bureau of Plant Industry, Soils, and Agricultural Engineering. Division of Cereal Crops and Diseases, Hays, Kansas.)

19 Effects of four 2,4-D sprays and two 2,4-D dusts on field bindweed when applied at four different rates on three stages of growth at Scotland, South Dakota in 1947. Derscheid, Lyle A. and L. M. Stahler. Randomized square rod plots of field bindweed were treated in duplicate with the butyl ester, and the triethanol amine, monohydrate sodium and ammonium salts of 2,4-D as sprays and with the methyl ester and sodium salt dusts at the rates of 5/8, 1 1/4, 1 7/8, and 2 1/2 pounds of 2,4-D acid per acre when the bindweed was in the spring rosette, full bloom, and fall rosette stages of growth. Treatments were made June 5, June 22 and September 18 when temperatures were 70° F or above and when soil moisture was high. Sprays were applied in 40 gallons of water per acre and exact amounts of 2,4-D were used. Amounts of 5% dusts were very close to the specified rates but not exact. Live plant counts were made, on treated plots, on June 1st, 1948 and compared with the original counts to obtain the per cent kill. All spray treatments produced over 90% control with the exception of the ammonium salt when applied in the fall. The dusts were over 80% effective in all cases. This study indicates that 5/8 pound of 2,4-D acid per acre in any formulation is sufficient to control field bindweed if applied during good growing conditions, but the over-all averages indicate that dusts are slightly less effective than sprays at comparable rates of application. (Contributed by the Agronomy Department of the South Dakota Agicultural Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. D. A.)

20 Effects of three formulations of 2,4-D on field bindweed when applied at three different rates under different growing conditions in South Dakota. Derscheid, Lyle A., and L. M. Stahler. Randomized square rod plots of field bindweed were treated in duplicate with the butyl ester, triethanol amine salt and monohydrate sodium salt of 2,4-D at the rates of 1/4, 3/4 and 1 1/4 pounds of 2,4-D acid per acre. All treatments were made in 1947 when the weed was starting to bloom. Applications were made in Beadle, Edmunds, and Lyman Counties when the soil was very dry, and no rain was received for some time after treating. The plots in Roberts county had been mowed at blooming time and applications were made on re-growth when it was starting to flower in August, but soil moisture conditions were good. Applications were made in Clay and Kingsbury counties under favorable growing conditions. Live plant counts were made during June of 1948 when all plants had emerged, but were still in rosette. Percent of kill was obtained by comparing counts from treated plots with those of untreated plots. The 1/4 pound rate was not effective on plots treated under adverse conditions as a 77.9% kill was the best obtained on any plots with an average of 59.7% for the ester 66.5% for the amine and 64.3% for the sodium. Under favorable growing conditions 1/4 pound of the amine produced a 92.3% kill whereas the same rates of the ester and sodium were 89.3% and 88.7% effective, respectively. Under adverse growing conditions, the 1 1/4 pound rate was slightly more effective than the 3/4 pound rate. The 3/4 pound rate gave an average of 78.1%, 89.2% and 66.7% kill for the ester, amine and sodium, respectively, whereas, the higher rate produced 86.2%, 82.4% and 80.2% elimination respectively. Under good growing conditions there was little difference between the two rates as all treatments produced 92.8% or more elimination. All formulations were equally effective when 1 1/4 pounds were used, but the amine was slightly more effective at each of the six locations when 3/4 pound was used and it was slightly more effective at 4 locations when 1/4 pound was used with the ester and sodium each producing a better kill at one location.

These data indicate that 3/4 pound 2,4-D acid per acre is sufficient to control field bindweed in South Dakota and that even less may be used under good conditions. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. D. A.).

21 The effects of five formulations of 2,4-D on field bindweed when applied at three different growth stages at Scotland, South Dakota in 1946. Derscheid, Lyle A. and L. M. Stahler. Duplicate square rod plots were treated with the anhydrous sodium, ammonium and triethanol amine salts and the ethyl and butyl esters of 2,4-D at the rates of 2/3, 1 1/3, 2 and 2 2/3 pounds of 2,4-D acid in eighty gallons of water per acre when the bindweed was fully emerged, in full bloom , and in fall rosette in 1946. No retreatments were made but plant counts were made June 1st of 1947 and June 1st of 1948 when surviving plants were fully emerged. Spring treatments were made May 28, two weeks after a killing frost, when there was a below average amount of soil moisture. The esters ranked first in effectiveness, followed by the amine with the ammonium and sodium salts being the poorest, but no treatments gave better than a 50% kill. The full bloom treatments were made July 9th, when there was an abundance of soil moisture and warm temperature. All treatments produced over 85% control which lasted until 1948. There appeared to be no difference in formulations. The fall treatments were made on September 11th, after having had 7.5 inches of rain the preceding month. Counts in 1947 revealed an 85 - 90% kill, but 1948 counts indicated that there was only a 60 - 70% kill with no apparent differences in formulations or rates. This study indicates that 2/3 pound of 2,4-D is as effective as 2 2/3 pounds for the control of field bindweed and that all formulations are equally effective at these rates. It also indicates that field bindweed that is treated in full bloom under good growing conditions does not need to be treated oftener than every three or more years. Some plants of fall treated bindweed that appear to be dead the following spring will be slow in emerging and may show up later that year. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. D. A.).

22 Control of Field bindweed with 2,4-D. Slife, F. W., R. F. Fuelleman. Ester and amine preparations were applied to field bindweed (Convolvulus arvense) growing in corn. Rates used were 1/3, 1/2, and 2/3 pound acid per acre. These applications were made on June 26 and observations and data obtained on October 1 indicated that there has been less than 10 percent regrowth on all treated plots. Growing conditions during the treatment period were exceptionally good with ample rainfall throughout the summer. Bindweed growing in thick bluegrass sod was treated twice with ester and amine forms of 2,4-D at 1/3, 2/3 and 3 pounds of acid per acre. The kill has been unsatisfactory, and as of October 1, 1948, there has been from 75 to 100 percent regrowth on all treated plots. The same methods of application were used on both series of bindweed plots however, the heavy bluegrass sod may account for the poor results in the latter case. Fall applications made in September on bindweed has eradicated top growth, but root samples show that the root system is alive at 8 inches below the surface of the ground. This may indicate that 2,4-D material is not translocated as deeply by fall applications as by spring sprayings. (Contributed by the Illinois Agricultural Experiment Station.)

made earlier in the season and (2) that field bindweed can be controlled and probably eliminated in Kansas by properly conbining applications of 2,4-D and a competitive sod forming crop. (Contribution of the Kansas Agricultural Experiment Station)

26. The effect of 2,4-D on field bindweed when used in conjunction with various cultural treatments at Scotland South Dakota. Derscheid, Lyle A. and L. M. Stahler. Three duplicate sets of 1/10 acre plots (1, 2 & 3) were seeded to oats in 1947, divided in-to thirds when the bindweed was beginning to bloom (June 21) and each third sprayed with the butyl ester, triethanol amine or sodium salt of 2,4-D at the rate of 1 pound of 2,4-D acid per acre. Two of these three sets (1 & 2) were spring plowed in 1948. One set (1) was seeded to oats and the other (2) was seeded to corn. The third set (3) was fall plowed in August, cultivated twice at two week intervals and seeded to rye in late September. Over 91% of the bindweed was eliminated by all chemical treatments on these three cultural treatments. Three other duplicate sets of 1/10 acre plots (4,6& 7) were cultivated at two-weed intervals from June 1 to July 1, 1947 (3 cultivations) and left idle until the bindweed began to bloom (Aug. 11), divided into plots 1 X 2 rods in size and sprayed with each of the three formulations at the rates of $\frac{1}{2}$ and 1 pound of 2,4-D acid per acre when soil moisture was very low. One set of plots (4) were plowed 38 days later (Sept. 18) and seeded to rye. The other two sets (6 & 7) were seeded to alfalfa and brome grass, respectively, in 1948. Spray applications were made when rate of growth was slow, but the plots that were fall plowed, had 95.8%, 88.2% and 87.2% control for 1 pound of the ester, amine, and sodium respectively. The $\frac{1}{2}$ pound rates produced 91.4%, 66.5% and 54.0% control for the same chemicals, indicating that the faster working ester did more damage to the weeds before the plowing was done. The plots that were not fall plowed had unsatisfactory control which ranged from 10.5% to 48.6% indicating that the 2,4-D had weakened the weeds and that the plowing killed them before they recovered. A seventh set of duplicate 1/10 acre plots (5) was cultivated at two week intervals from June 1 to August 1 in 1947 (5 cultivations) and left idle until the bindweed began to bloom (Sept. 18) and soil moisture conditions were more favorable. This set of plots was divided into plots 1 x 2 rods in size and treated with all three formulations at the $\frac{1}{2}$ and 1 pound rates. One week later rye was seeded into these plots. Over 92.% control was obtained on all plots except those treated with $\frac{1}{2}$ pound of the ester which caused 62.4% elimination. This study indicates that bindweed can be controlled by spraying with 2,4-D in grain and that the weed will be under control in corn the following year. It also indicates that rye and fallow do not increase the effectiveness of 2,4-D in grain and that late fall plowing may serve as an aid to 2,4-D that has been applied late or under adverse growing conditions. These indications need to be substantiated by further investigation, however. (Contributed by the Agr. Dep. of South Dakota Agr. Exp. Sta. and the Bureau of Plant Industry, Soil and Agr. Engineering USDA.)

23 Controlling Field Bindweed in Cereals with 2,4-D. Wood, H. W. and J. J. Bourns. Encouraging results in knapsack spraying field bindweed in the bud-flower stage in cereals led to field trials 1947-48. Stubble land moderately infested was sprayed in the early September, 1947, and the land plowed in October, and planted to barley in 1948. In the same field, in early July, other plots were sprayed, the bindweed in flower, the barley headed. Ester was applied in the fall 2 pounds acid per acre and 1/2 pound in the spring; amine 2 pounds in the fall, 1/2 and 1 pound in the spring. Control on all plots was satisfactory, and was estimated between 80% - 90% elimination of bindweed. Very marked Canada thistle and perennial sow thistle control was obtained, more especially on the spring treatments. (Contribution of the Weeds Commission. Manitoba Department of Agriculture, Winnipeg, Canada.)

24 Treatment of field bindweeds in growing wheat with 2,4-D. Elder, W. C. On September 22, 1947, a seedbed was prepared in a bindweed infested area and planted to winter wheat. One month later this field was divided into 1/2 sq. rod plots and counts made of the bindweeds on each plot. At this time 4 replications each of 1/2, 1 and 2 pounds per acre each of an ester and a salt formulation of 2,4-D was applied. The same treatments were applied again on April 30, 1948, when bindweed was in the bud stage and wheat in boot stage. After harvesting the wheat the area was sufficiently cultivated to keep down seedlings and recounts on the surviving bindweeds were made in October, 1948. All treatments of 1 and 2 pounds of both formulations of 2,4-D gave about the same percentage of kills. The fall applications gave approximately 10% more kill than spring applications. The salt type used at 1/2 pound per acre killed 40% to 50% of the bindweeds, while the ester used at 1/2 pound per acre killed 60% to 70%. The heavier applications eradicated 80% to 95% of the bindweeds. Difficulty in getting complete coverage of the leaves of the bindweeds in tall wheat may account for the lower percent of kills in the spring applications. (Okla. Agri. Exp. Sta.)

25 Control of field bindweed (Convolvulus arvensis) by the use of 2,4-dichlorophenoxyacetic acid and bromegrass as a competitive crop. Zahnley, J. W. and G. L. McCall. An area fully infested with bindweed was plowed under July 25, 1947. On October 1 a heavy regrowth was treated with 1 pound per acre of 2,4-D acid in the ester form in 40 gallons of water. The top kill was slow but complete before the first killing freeze. By April 25, 1948, only 5% of the original stand of bindweed had emerged. The area was then divided into three parts, one of which was planted to bromegrass, one to a mixture of perennial ryegrass and bluegrass and the other, three weeks later, to corn. Across these cropped areas duplicate plots of 1/20 acre each were sprayed on June 10 with 2, 4-D ester, triethanol amine, and monohydrate sodium salt at rates of 1/2 and 3/4 pounds of acid per acre. The growth consisted of less than 2-% of the original bindweed stand and a fairly thick growth of annual weeds which were choking the grasses and corn. The 3/4 pound rate of ester killed nearly all the broad leaved weeds but caused some burning of the leaves of the corn and bromegrass. The grass plots were mowed high August 15 to remove a heavy growth of crabgrass and other annual weeds. On October 1 when all plots were retreated the stand of bindweed remaining on the plots treated with esters, amines and salt was reduced to 1, 4 and 4 percent of the original stand respectively where seeded to grass, and 5 to 15 percent in the corn. This and other similar tests give evidence (1) that late fall applications of 2,4-D are more effective than those

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS.

Regional Summary
Prepared by A. L. Bakke

Canada thistle shows marked tolerance to treatments with 2,4-D. In the majority of cases the ester formulations have given better results than the amine or sodium salt formulations. Where a number of treatments have been made there appeared to be little difference in the formulation. The above-ground growth can be killed back with concentrations as low as 8 ounces of the acid evuivalent per acre, once the plant has reached the bud stage. The degree of effectiveness is more or less in direct proportion to the rate of the acid per acre. In growing crops it is of course necessary to take into consideration the tolerance of the crop. Canada thistles growing in corn can be controlled by using an ester formulation of 1/3 pound acid equivalent per acre. In small grain, a higher concentration may be used. Two treatments each year for two years will not eradicate this weed but three usually will. One pound of the acid equivalent per acre appears to be sufficient. 2,4,5-T did not prove to be more effective as a herbicide than 2,4-D.

Abstracts of Results of Individual Cooperators.

27 Effect of foliage sprays with various 2,4-dichlorophenoxyacetic acid formulations on Canada thistle (Cirsium arvens (L) Scop). Brown, D.A. During 1948 a dense infestation of this weed was used to test the killing effect of the ester, amine and sodium salt formulations of 2,4-D. Plots were one square rod in size. Concentrations of $\frac{1}{2}$, 1, 2 and 3 pounds of acid per acre were used. Treatments were given at pre-bud (June 20), full flower (mid-July) and post-bloom (mid-August). No repeated sprayings were made. Very little killing of foliage occurred after the June 20 sprayings from any formulation at any of the rates used. Good kills were obtained at full flower stage but roots appeared so slightly affected that regrowth took place up to 90 to 100 per cent. August sprayings gave excellent kills of all top growth at all concentrations from one pound up and with all formulations. October readings indicated a fair root kill, but estimates of re-growth will be more accurate for the late spraying when readings are taken on these plots in 1949. On the basis of our 1948 results we would say that top growth of Canada thistle can be killed back satisfactorily with concentrations as low as 8 ounces acid per acre of all three formulations once plants have reached the bud stage, but that root killing is only fragmentary when a single treatment is used. (Contribution of Field Husbandry Division, Dominion Experimental Farm, Brandon, Manitoba).

28 The effect of 2,4-D on Canada thistle. Corder, A.C. In 1947 a triethanolamine salt and butyl ester were used at 2, 4 and 8 pounds acid equivalent per acre on a well established infestation of Canada thistle (Circium arvense). Treatment was made when the thistle was in the full bud stage with the resprouts treated in autumn. The early summer and fall treatments were repeated in 1948. At the end of this season the ester at the 2, 4 and 8 pound rates had reduced the stand by 68, 75 and 83 per cent, respectively The amine treatments were much less effective. In 1948 2,4,5-T was used at 2 and 4 pounds acid equivalent per acre but proved less effective than the ester of 2,4-D at the same rates. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

29 Effect of 2,4-D in the control of Canada thistle (Cirsium arvense.) Friesen, H. A. During 1948 three formulations of 2,4-D were applied to Canada

thistle at dosages of 1/2, 3/4, 1, 2 and 3 pounds acid equivalent per acre. The treatments were made at four stages of growth, viz: 1) spring rosette, 2) first bud 3) full bloom and 4) fall rosette.

Treatments made during the first three stages of growth resulted in complete killing of all the top growth where the ester was used in excess of 1/2 pound per acre. The ester at the 1/2 pound rate resulted in 80 per cent killing of the top growth. The amine and sodium salt formulations were less effective in killing the top growth, when compared with similar dosages of the ester. All treatments made during the fall rosette stage had only a curling effect on the leaves.

Root kills in 1948 appeared to be very poor. Six weeks after treatment, regrowth was almost 100 per cent on all plots, this is at variance with the results of similar treatments made in 1946 and 1947. In those years regrowth on plots treated with the ester at dosages of 1 pound per acre or more showed only from 5 to 15 per cent regrowth. The amine and sodium salt treated plots showed 40 to 60 per cent regrowth. Regrowth in 1946 and in 1947 was 20 to 40 per cent more abundant on plots treated in the spring rosette stage than it was on plots treated in the first bud or full bloom stages. The poor root kills observed in 1948 may be due to the extremely hot dry seasonal conditions. (Contribution of Dominion Experimental Station, Scott, Sask.)

30 Effect of various 2,4-dichlorophenoxyacetic acid formulations sprayed at 3 different growth stages with 3 different rates on Canada thistle (Cirsium Arvensis) and Sow thistle (Sonchus Arvensis) in the growing crop. Leggett, H. W. Stages were 2" - 4" in height, 6" - 8" in height, and early bud. Formulations were sodium, triethanolamine and butyl ester salts of 2,4-dichlorophenoxyacetic acid at rates of 3/4, 1, and 1 1/2 pounds acid per acre applied to square rod plots. Rates over 3/4 of a pound acid per acre in practically all cases caused damage to the crop. Both Canada and Sow thistle were as effectively controlled at the early stage of growth as any other stage. Canada thistle is somewhat more susceptible to 2,4-dichlorophenoxyacetic acid formulations and rates than is Sow thistle. Both weeds are more effectively controlled by the butyl ester formulation than with the triethanolamine or the sodium salt and similarily the triethanolamine is more effective than the sodium formulation. The degree of effectiveness of control of Canada and Sow thistle is in direct proportion to the rate of acid per acre of either 3 of the formulations applied. There is some indication from work done in 1947 that the decrease in percentage stand of these weeds is in proportion to the amount of chemical applied. Further results on this phase will not be available until 1949. (Contribution of Dominion Experimental Farms, Field Husbandry Division, Lacombe, Alberta, Canada.)

31 Effect of various systemic (hormone) herbicides on Canada thistle at the late bloom stage. Pavlychenko, Thomas K. Eighty, 16 x 100 foot plots on the Saskatoon sandy loam infested with Canada thistle were treated at the late bloom stage, July 23, with Weedone concentrate 48, Weedone No. 5 (ethyl esters, 2,4-D), LFN 549 (ester, 2,4,5-T) and with various combinations of the three esters at rates of 8, 16, 24 and 32 ounces of acid equivalent per acre. In addition, LFN 549 was used at 40 and 48 ounce rates. The top growth in one half of the plots treated with LFN 549 and Weedone concentrate 48, was cut prior to treatments. Results: the records taken 75 days after treatments indicated that the top growth was killed 82 (8 oz/a rates) to 96 (32 oz/a) pct. by Weedone No. 5; 78 to 93 by Weedone concentrate 48 and 67 to 9 by LFN 549 at the corre-

sponding rates. There was from .2 to 1.6 per cent regrowth in the uncut plots and 12 to 70 per cent over the cut areas of the LFN 549 and Weedone concentrate 48 plots. The top growth of the wild rose bush abundantly present in some plots was uneffected by Weedone No. 5 or Weedone concentrate 48, but was 100 pct. killed by LFN 549. It was not possible to estimate the extent of damage to roots at that time and the final records will be taken in 1949. (Contribution of Agr. Field Res., American Chemical Paint Co., Ambler, Pennsylvania.)

32 Effect of various systemic (horome) herbicides on Canada thistle (Cirsium arvensis) at the late rosette stage. Pavlychenko, Thomas K. Canada thistle was treated at the late rosette stage with Weedone concentrate 48, Weedone No. 5 (ethyl esters, 2,4-D) and LFN549 (ester, 2,4,5-T). The three esters were applied alone and in various combinations at rates of 8, 16, 24 and 32 ounces of the acid equivalent per acre. In addition, LFN549 was used at 40 and 48 oz/a rates. Results: the records taken three months after the treatments were appraised on the basis of (a) top growth kill (2) regrowth in per cent of the original stand and (3) root damage. The top growth was 100 per cent killed in 30 to 34 days in all plots by Weedone concentrate 48; in 32 to 38 by Weedone No. 5 and in 32 to 41 days by LFN549. Regrowth occurred in all plots, in the Weedone No. 5 treatments from 5(32 oz/a) to 25 (8 oz/a) pct. of the original stand; Weedone concentrate 48, 28(32 oz/a) to 64(8oz/a) pct, and in LFN549 from 9(48 oz/a) to 60 (8 oz/a) pct. The combination treatments were effective according to the strength of the more active component member. Approximately 8 pct. of the new shoots in the Weedone No. 5 plots died and about 25 in the LFN 549 produced immature heads. Weedone No. 5 alone caused an appreciable root damage. The three chemicals ranked in their effectiveness, from high to low, as follows: Weedone No. 5, Weedone concentrate 48 and LFN549. (Contribution of Agr. Field Res. American Chemical Paint Co., Ambler, Pa.)

33 The effect of 2,4-D on Canada thistle. Wood, H. E., Bourns, J. J. Further trials and field observations confirm earlier findings to the effect that this weed shows marked tolerence to 2,4-D even at heavy rates of application. Repeated treatments, especially when the weed is in competition with grass, and sprayed in the bud to early flowering stage has given promising results. The ester around 1 1/2 pounds acid per acre appears most effective. When treated in the active pre-bud stage, while the plant is killed back, it soon recovers. Where Canada thistle is a problem in a growing crop a considerable measure of control is being obtained by spraying at the maximum to slightly more than the recommended dosage for the crop; growth is checked sufficiently, when in competition, that the weed is less troublesome at harvest. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada.)

34 Control of Canada thistle with 2,4-D. Slife, F. W. and R. F. Fuelleman. Applications of 1/4, 3/4 and 3 pounds acid in ester and amine formulations, and 1/2, 1 and 4 pounds acid in the sodium salt form per acre were applied in the pre-bud stage to Canada thistle. Treatment dates were May 5 repeated on July 7. Regrowth counts on October 5, indicate about 85 per cent control with the heavier rates of amine and ester types, and about 60 per cent control with 4 pounds of acid in the sodium salt form per acre.

Lighter rates on all formulations decreased stands of thistles by approximately 20 per cent.

Applications of various 2,4-D formulations at pre-bloom stage were not as effective as those made in the pre-bud stage.

Kills of Canada thistle growing in bluegrass sod were not as good as kills of thistles in open and cultivated areas. (Contribution of Ill. Agr. Exp. Sta.)

35 The response of Canada thistle (Cirsium arvense) to herbicidal applications. Miller, John H. 2,4,5-T acid and the sodium salt, the triethanolamine salt, and the isopropyl ester of 2,4-D were applied to Canada thistle in which the 1948 treatments were repeated on plots which had received a like treatment in 1947, except that 2,4,5-T was applied in 1948 to new plots in an adjacent area. Observations, based on plant counts, indicate little or no difference in formulations of 2,4-D. The same was true in the comparisons of 2,4-D and 2,4,5-T. The spring rosette and bud stages of growth appear to be much more satisfactory than the fall regrowth stage for herbicidal applications. One-half pound of acid per acre was slightly less effective than applications of higher concentrations. Applications of 1 and 2 pounds per acre appeared to be equally effective, both giving fair control. For 1948, 1.5 pounds per acre gave the best control, reducing stands based on spring and fall counts by 80 per cent. All applications were made using a volume of 40 gallons of spray solution per acre. (Contribution of the U.S.D.A., Bureau of Plant Industry; the Division of Agronomy and Plant Genetics and Plant Pathology and Agricultural Botany, University of Minnesota; and the Weed Division of the Bureau of Plant Industry, Minnesota State Dept. of Agriculture.)

36 Control of Canada thistle with 2,4-D and other herbicides. Bakke, A. L. Canada thistles growing in oats in northern Iowa were treated twice with 14 different chemical compounds. The first treatment was made when the plants were in the bud stage and the second the latter part of September. From the first spraying there was not much difference in the results from using the sodium, amine or ester formulations of 2,4-D; the same could be said for the trichlorophenoxyacetic acid (Butyl ester) and the trichlorophenoxyacetic acid (Isopropyl ester) at the 1/2 pound and the one pound rates. The number of regenerated plants after the first spraying was in several cases greater than the original counts, but the plants were smaller. Two weeks after the second spraying, the majority of the thistle plants were yellow green in color and bent over. Final results cannot be made until next year.

Canada thistles in corn were sprayed with 1/3 pound per acre 2,4-D acid equivalent of a butyl ester formulation when the corn was 2-3 feet in height. The thistles about to bud became yellow in color and failed to develop further. Although the corn in many cases became brittle and bent-over shortly after the spraying, straightened and showed no permanent injury.

A heavy stand of Canada thistles treated twice with 1000 p.p.m. of the acid equivalent of 2,4-D in 1945 and again in 1946 had from 15 to 56 plants per square on August 20, 1947. With one spraying of an ester formulation on September 25, 1947, the number of thistle plants in 1948 ranged from 0 to 7 per square rod. It is evident that the eradication of Canada thistle is at least a three year proposition. (Iowa Agricultural Experiment Station, Botany and Plant Pathology Section.)

37 Eradication of Canada thistle in bluegrass pastures at Columbus, Ohio. Willard, C. J. and Warren C. Shaw. Over 200 square rod plots of Canada thistle in pastures, treated in 1946 and 1947 (See Proceedings 3rd Annual Meeting NCWCC, pages 51-52, and 4th Annual Meetings, page 188) were continued in 1948. They were mowed in June and treated in August with 2 pounds acid equivalent per acre of the butyl ester of 2,4-D. Practically every plot had

a considerable number of thistle sprouts (some into the hundreds) this spring, but now (November 1, 1948) there is an average of about 1 sprout per plot. This confirms previous observation that two year's treatment will not ordinarily eradicate vigorous thistles in pastures, but that three usually will. Some further treatments must be made on some plots, but 2,4-D provides a method of eradicating Canada thistle in bluegrass pastures without killing the grass. We would recommend two treatments each year - about June 1 and September 1, One pound acid equivalent per acre may be sufficient, but we would prefer to use 2 pounds on Canada thistle patches. (Contribution from the Ohio Agr. Exp. Station.)

38 The effect of treating Canada thistle in Butte county with 2,4,5-T and with three formulations of 2,4-D at four rates of application. Derscheid, Lyle A. and D. E. Kratochvil. Square rod plots of Canada thistle were treated in triplicate with the butyl ester, the triethanolamine salt and the monohydrate sodium salt of 2,4-D and with 2,4,5-T at the rates of 1/2, 3/4, 1 and 1 1/2 pounds of acid per acre. The treatments were made on June 18,1948, when the thistles were in full bud and spines were hard. A rainy spell had just started at the time of treatment. Live plant counts were made on September 14, 1948 and all plants that had green color in the stems were counted as live plants. Counts from treated plots were compared with those from untreated plots to determine the per cent of kill. There appeared to be little difference in the effectiveness of the various 2,4-D formulations, but the 2,4,5-T was much less effective. When 1/2 pound was used 77.1% control was obtained by the ester, 71.9% by the amine, 75.9% by the sodium and 49.1% by the 2,4,5-T. This is compared to the 90.2% control by the ester, 86.3% by the amine, 86.1% by the sodium and 64.1% by the 2,4,5-T when 1 1/2 pounds were used. This may indicate that the ester is most toxic and the 2,4,5-T the least toxic with the amine and sodium about equal, but the counts were made only three months after the treatments and some plants that retained green color will probably die later, indicating that the ester works fastest, the 2,4,5-T the slowest and the other two about equal. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station.)

39 The effect of treating Canada thistle in Lawrence county with 2,4,5-T and two formulations of 2,4-D at three rates of application. Derscheid, Lyle A. and D. E. Kratochvil. Square rod plots of Canada thistle were treated in duplicate with the butyl ester and triethanolamine salt of 2,4-D and with 2,4,5-T at the rates of 3/4, 1 and 1 1/2 pounds of acid per acre. The applications were made on June 19, 1948, when the thistles were budding. Live plant counts were made on September 18, 1948, when fall rosettes were present. All plants that had green color in the stem were counted as being alive. Counts of untreated plots were compared with those of treated plots to determine the per cent killed. The lowest rate of application was as effective as the highest rate for all three chemicals. A 92.7% control was obtained where 3/4 pound of the ester was used, and 82.9% for the amine, but only 69.2% for the 2,4,5-T. Counts were made three months after the treatment and a large number of plants that may die later still retained some green color indicating that the ester works the fastest and 2,4,5-T the slowest. It may also indicate that 2,4,5-T does not give effective control of this weed. (Contributed by the Agronomy Department of South Dakota Agricultural Experiment Station.)

40 The effect of treating and retreating Canada thistle in Grant county with three formulations of 2,4-D at three rates of application. Derscheid, Lyle A., L. M. Stahler, and D. E. Kratochvil. Square rod plots of Canada thistle were treated in duplicate with the butyl ester, triethanolamine salt,

and the monohydrate sodium salt of 2,4-D at the rates of 1/4, 3/4 and 1 1/4 pounds of 2,4-D acid per acre. The original application was made July 8, 1947 when the thistles were in full bud. Retreatments were made September 8, 1947 on the fall rosettes, and July 10, 1948 when budding. Live plant counts were made on September 8, 1947, June 8, 1948 and September 15, 1948. The per cent of eliminated plants was based on a comparison of treated and untreated counts. In June 1948 the live plants on treated plots were in the rosette, while untreated plants were budding, indicating that the growth of treated plants had been delayed. Retreatments of 3/4 and 1 1/4 pounds of the amine and sodium salts did not decrease the stand materially; whereas, retreatments with the ester did decrease the stand. The end results of all chemicals at comparable rates were approximately equal at the end of two years, however. The 1/4 pound rate of the amine and sodium salts produced at 78.6% and 78.3% reduction in stand, respectively. A range of 88.8% to 92.4% reduction in stand was obtained on plots treated with 3/4 pounds or more 2,4-D acid per acre indicating the 3/4 pounds of any formulation was, for all practical purposes, as effective as the higher rate. Complete elimination of Canada thistle cannot be accomplished easily with 2,4-D and this chemical can only be used as a control measure. Since retreatments are necessary 3/4 pound and possibly less 2,4-D acid per acre may be used for practical and economic control of this weed. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A.)

41 The effect of treating and retreating Canada thistle in Roberts county with three formulations of 2,4-D at three rates of application. Derscheid, Lyle A., L. M. Stahler, and D. E. Kratochvil. Square rod plots of Canada thistle were treated in duplicate with the butyl ester, triethanolamine salt and monohydrate sodium salt of 2,4-D at the rates of 1/4, 3/4 and 1 1/4 pounds of 2,4-D acid per acre. The original treatment was made July 8, 1947, when the thistles were in full bud. Identical retreatments were made September 8, 1947, on the fall rosettes and on June 8, 1948, when the thistles were budding. Live plants were counted on all plots on September 8, 1948, June 8, 1948, and September 15, 1948. Counts from treated plots were compared with counts from untreated plots to determine the per cent of plants that had been eliminated. The per cent elimination increased with subsequent retreatments when 1/4 pound of 2,4-D acid was applied and when the higher rates of the ester were used. This was not true for the higher rates of the amine and sodium salts. The end results with all chemicals at comparable rates, was approximately the same after two years. It appears that 2,4-D can be used as a control measure but not as an eradicator. Since several retreatments are necessary 3/4 pounds and possible less 2,4-D acid per acre may be used for practical and economic control. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.)

42 Effectiveness of three preparations of 2,4-D used at three rates in controlling Canada thistle (Circium arvense). Buchholtz, K. P. One-half square rod plots of Canada thistle in Miami silt loam crop land were treated with 1.0, 2.0 and 4.0 pounds per acre of 2,4-D as the acid equivalent in the sodium salt, amine and butyl ester preparations using water equal to 120 gallons per acre. Shoot counts were made prior to treatment on July 11, 1947 and again in May 1948. The thistles were in the late bud stage at the time of application. No cultivation of the crop was allowed following the spray treatment. Three replicates were used and the data were analyzed statistically. All treatments gave significant reductions in shoot numbers with reductions

ranging from 61.8 to 89.1 per cent. Check plot infestations increased 51.6 per cent in the same period. There were no significant differences between the average percentages of reductions obtained with the three preparations, which were 74.8, 74.7 and 77.1 per cent respectively for the sodium salt, amine and butyl ester preparations. The higher rates of applications gave the greater average reductions being 66.3, 76.8 and 85.7 per cent for the 1, 2, and 4 pound per acre applications. The 4 pound application gave a significantly greater reduction than the 1 pound per acre rate. (Dept. of Agronomy, Univ. of Wisconsin, Madison, Wisconsin.)

43 Use of 2,4-D in control of Canada thistle (Cirsium arvense) Bohmont, Dale W. Rod square plots replicated two times were sprayed with 1/4, 3/4, 1 1/4 and 2 pounds of the butyl ester, alkinolamine and sodium salt of 2,4-D. All plots were sprayed at the rate of 40 gallons per acre. Plots were treated at the pre-bloom stage of growth in July 1947, and three, square foot quadrat counts were taken at definite locations in each plot. Survival counts were taken in the same location in July 1948 and data computed on a per cent survival basis. Although many of the survival counts equaled or exceeded the primary count there was a definite trend toward control in the amine treatment spraying. The two pound amine treatment gave a 29.7% survival (70.3% kill) compared to 160% survival for the two pound ester and 106.2% survival for the two pound salt. In both the 3/4 pound and 1 1/4 pound concentrations the amine treatment resulted in a lower per cent survival than either the salt or ester. By the analysis of variance the two pound amine treatment was significant to the 5% point compared to the two pound ester and two pound salt treatment. (Contributed by University of Wyoming, Agronomy Department.)

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS.

Hoary Cress Investigation leader: J. W. Zahnley

Results of applications of 2,4-D on hoary cress were reported from six locations, one in Wyoming, one in Kansas and four in Canada. In four of these complete kills were obtained by repeated treatments carrying into the third season. In no case was the weed killed in one season with repeated treatments. Three investigators reported better results from treatment of hoary cress in grass sod than on cultivated land. The esters appear to be more effective in most cases than the amines or salts. Treatment in the bud to full bloom and in the fall rosette stages is most effective. The rates used in the investigations reported ranged from as low as ¼ pound to 4 pounds of 2,4-D acid per acre. Two pounds seems to be the minimum for consistently good results. In all cases where complete kills were reported two pounds or over were used and one investigator stated that two pounds was definitely better than one. Results reported show that hoary cress can be eradicated by the use of 2,4-D but it will probably require five or six applications spread over a period of three years. Establishing grass on the infested area as a supplement to the 2,4-D treatments seems to be good practice.

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS.

Abstracts of Results of Individual Cooperators.

Hoary Cress

44 The use of 2,4-D in the control of hoary cress (Lepidium draba). Bisal, F. In reporting results of tests started in 1946 it was stated that there was regrowth of the hoary cress after treatment with 2,4-D. The plots which were sprayed in 1946 and 1947 with 2, 3 and 4 pounds of 2,4-D acid per acre show very good results in 1948. On plots which have not been cultivated since 1945, there is an apparent kill of 100% of the hoary cress, however in the fall of 1948 the plots are covered with other weeds. Results on plots which had been cultivated are not nearly so good and show at least 30% regrowth. Work carried on in 1948 shows results similar to these obtained heretofore with one seasons treatment. The tops of the hoary cress are killed, but there are new buds appearing on the roots. A heavy regrowth is expected next spring on plots which have been treated this year. (Contribution of Dominion Soil Research Laboratory, Swift Current, Saskatchewan.)

45 The use of 2,4-D in control of hoary cress (Lepidium draba). Bohmont, Dale W. Rod square plots replicated two times were sprayed with ¼, 3/4, 1¼ and 2 pounds of the Butyl Ester, Alkanolamine and Sodium Salt of 2,4-D. All material was applied at the rate of 40 gallons per acre, at the early bloom stage of growth in July 1947. Quadrat counts were taken shortly after spraying and survival counts taken in July, 1948. The data was computed on percentage survival basis. The results were very uniform indicating no definite pattern as to the most effective material and concentrations to be used. Stands under all treatments were reduced compared to the untreated check, which had a regrowth of 80.5%. The Ester formulation gave the lowest survival (41.3%), followed closely by the Amine (42.1%), and last by the salt (50.4%). The lowest survival count of any one treatment was found in the 1¼ pound Amine treatment, however, the differences were insignificant by the analysis of variance. (Contribution of the Wyoming Agricultural Experiment Station.)

46 The use of 2,4-Dichlorophenoxyacetic acid in control - hoary cress (Lepidium draba). Brown, D. A. An experiment was laid down on a uniformly heavy infestation of hoary cress - pure stand - in 1947. Seventy-seven quarter square rod plots were used and treatments replicated. Treatments in 1947 were made at full emergence, pre-bud, full bloom and fall rosette. One range of plots was used for repeated sprayings. Formulations used were; ester, amine, and sodium salt at concentrations of one and two pounds acid per acre. Applications were made with a knapsack sprayer using 120 U.S. gallons of water per acre. Final readings were made in 1947 on Oct. 6. On the once sprayed plots best results were obtained from treatments done when the plants were in full bloom and fall rosettes stages. All single treatments killed back above ground growth effectively but regrowth up to 60% appeared on the majority of plots by October. Little difference appeared between formulations, but the two pound rate gave distinctly better kills than the one pound concentration. All plots that received repeated sprayings in 1947, showed 100% killing of all above ground growth October 1947 and at least a 60% killing of roots. All plots

were carried over through 1948 in order to appraise the full effect of the 1947 treatments. Counts were made of plant stands in September 1948. Appreciable killing was indicated by all treatments at various stages of growth at both one and two pounds per acre, and for all three formulations with ester showing somewhat to advantage, amine medium, and sodium salt the least effective. Plots receiving repeated sprayings in 1947 showed very little regrowth especially on ester and amine formulations. In 1948 new sprayings included the use of ester only at 3 pounds acid per acre rates and in single treatments only, at pre-bud, full bloom, and post bloom stages. Results were comparable with the lower rates used in 1947. A series of plots were plowed and the turned up roots sprayed immediately with ester at 3 lbs. acid per acre. Results were almost negligible. Regrowth was almost 100% within a month after treatment. Summary. - (a) Single treatments of 1 or 2 pounds acid per acre of ester, amine and sodium salt killed from 40 to 80 percent of the stand. (b) Repeated sprayings (4) at 1 and 2 pound concentrations gave 90 to 100 percent kills. (Contribution of the Division of Field Husbandry, Dominion Experimental Farm, Brandon, Manitoba.)

47 The effect of 2,4-D in conjunction with a competitive crop on hoary cress (Lepidium draba). Carder, A. C. An investigation was commenced in the spring of 1946 to eradicate hoary cress by plowing and working down and seeding to a grass followed by 2,4-D treatments of 4 pounds acid equivalent per acre of a butyl ester. The cress was sprayed when possible at the late bud to early flower stage with two applications being made each season. Thriving infestations of cress were reduced to 20 percent of their original stands the first year, to 5 percent in the second, and to nil in the third. In the meantime the grass closed in and took over the area. Turf-forming grasses such as creeping red fescue, Kentucky blue, timothy, and crested wheat grass were used. Species of grass is not important providing it is adaptable to the soil conditions wherein the weed infestation exists. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

48 Effect of 2,4-D in the control of hoary cress (Lepidium draba). Friesen, H. A. In 1948 various formulations of 2,4-D and one formulation of 2,4,5-T were applied to hoary cress at dosages of ½, 3/4, 1, 2 and 3 pounds acid equivalent per acre. The treatments were made at four stages of growth viz: spring rosette, first bud, full bloom and fall rosette. The extremely hot, dry seasonal conditions resulted in a very slow growth rate of hoary cress. The plants were stunted and the foliage was dry throughout the entire season. These conditions were likely responsible for the poor kills of both the top growth and rootstocks of this weed in 1948. The ester at dosages of 1, 2 and 3 pounds per acre applied during the spring rosette and first bud stages checked the plants and resulted in a small degree of top growth killing. The other formulations of 2,4-D and 2,4,5-T resulted only in a very temporary checking of the growth rate with no killing of the top growth or the roots. Four weeks after the treatments all plots had recovered to the extent where it was impossible to discern any difference between the treated and the untreated plots. In 1946 and 1947 under more favorable growing conditions, similar treatments resulted in good kills of the top growth at the first three stages of growth. Root kills however, were almost nil in both seasons. (Contribution of the Dominion Experimental Station, Scott, Saskatchewan.)

49 The use of various 2,4-D formulations for control of hoary cress (Lepidium draba) in grass sod and in cultivated land. Zahnley, J. W. In 1947 a report was made on tests started in 1945 with various formulations and rates of 2,4-D applied to hoary cress in grass sod and on cultivated land. Applications were effective when made at bud stage in the spring and on the fall rosettes. After four treatments with rates ranging from 1.92 to 4.32 pounds of acid per acre complete eradication was indicated on nearly all plots Oct. 22, 1947. On June 1, 1948, eradication was complete in the bluegrass sod and in all except four plots in bromegrass where a trace of very weak plants remained. Rates of 1.92 pounds were ultimately as effective as the heavier rates. On cultivated land duplicate plots that were started in 1946 were continued through 1948. On the area where only 9 plants appeared in the fall of 1947, 30 plants were found in 1948. These emerged later than usual and were treated late in May. A trace of weak plants was in evidence when the ground was plowed in August. Eradication was completed with four applications on all but two plots at the end of 1947. These now have had five treatments and the weed is still not eradicated in the late summer of 1948. The following suggestions are believed to be worthy of consideration. The esters are more effective on hoary cress than other forms of 2,4-D. Plants continue to emerge for some time after the bud stage treatment and these should be spot treated three or four weeks after the general application. Only by repeated applications can hoary cress be eradicated with 2,4-D. (Contribution of the Kansas Agricultural Experiment Station.)

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS.

Miscellaneous Perennial Weeds · · Investigation Leader: George Knowles

Summary of this Investigation is arranged in tabular or "check list" form. Data for the following classification of perennial herbaceous weeds was derived from tabular reports of cooperators solicited through a special outline submitted early in the season.

In the previous classification of plants according to response to 2,4-D three groups were designated, susceptible, intermediate and resistant. The intermediate group was "catch-all" for those plants that were not easily killed or those that showed little or no response. Indications now are that the stage of growth at the time of treatment and the amount of 2,4-D applied may determine the end results. With this in mind the following classification of the susceptibility of perennial weeds to 2,4-D applications has been adopted.

I. (Very Sensitive) Any perennial plant that is controlled at its most susceptible stage of growth by one application of ½ pound or less 2,4-D acid per acre.

II. (Sensitive) - Any perennial plant that is controlled at its most susceptible stage of growth by one application of from ½ to 1 pound 2,4-D acid per acre.

III. (Semi-resistant) - Any perennial plant that is controlled at its most susceptible stage of growth by more than one application of up to 2 pounds, 2,4-D acid per acre.

IV. (Resistant) - Any perennial plant that is not controlled at any stage of growth by repeated applications of up to 2 pounds of 2,4-D acid per acre.

USE OF ROMAN NUMERALS:-

For the sake of brevity the above four Roman numerals are used in the accompanying tables to indicate the reaction of each perennial weed at the growth stage when the treatment was applied. e.g. (I) very sensitive (II) sensitive (III) semi-resistant (IV) Resistant.

ABBREVIATIONS:- A - amine; E - ester, S - sodium and T - 2,4,5-T.

CLASSIFICATION

When experimenters reported different amounts of 2,4-D required to control the same weed the range of difference is indicated but the classification is based on the lowest amount used.

COMMON NAME	SCIENTIFIC NAME	Formulation used and amount applied per acre	TYPE OF REACTION ACCORDING TO GROWTH STAGE				CLASSIFICATION
			Active growth pre-bud	First Flowering bud	Full bloom	Fall growth	
Artichoke, Jerusalem	Helianthustuberosus	1 lb.	II	II			Sensitive
Aster	Aster spp.	1½ lb. A.E.S.&T.	III	III	III		Semi-resistant
Bindweed, hedge	Convolvulus sepium	½ lb. A.E.&S. 1½ lb. E.	I III		III		Very sensitive
Bindweed, field	Convolvulus arvensis	¾ lb. A.E.S.T.	II	II	II		Sensitive
Bittersweet, climbing nightshade	Solanum Dulcamara						Resistant
Bouncing bet	Saponaria officinalis						Resistant
Buckhorn	Plantago lanceolata	⅛ lb. A.E.S. ½ lb.	I I				Very sensitive
Bull thistle	Cirsium lanceolatum	1 lb.	II				Very sensitive
Burdock	Arctium minus	½ lb. A 1 lb. E.	I II				Very sensitive
Carrot, wild	Daucus carota	1 lb.	II				Sensitive
Catnip	Nepeta Cataria	½ lb.	I				Very sensitive
Chicory	Cichorium Intybus	½ lb.	I				Very sensitive
Cockle, white	Lychnis alba Mill						Resistant
Cinquefoil	Potentilla sp.	½ lb.	I				Very sensitive

COMMON NAME	SCIENTIFIC NAME	Formulation used and amount applied per acre	Active growth pre-bud	First Flowering bud	Full bloom	Fall growth	CLASSIFICATION
Creeping Charley or Ground Ivy	Glecoma hederacea	½ lb.	I				Very sensitive
Cactus, prickly pear	Opuntia sp.	1½ lb. A.E.S.T.					Resistant
Cockle, white	Lychnis alba	1½ A.E.S.T.					Resistant
Clover, sweet	Melilotus sp.	(½ lb. (¾ E.	I				Very sensitive
Chickweed, field	Cerastium arvense	1 lb. S.	II		II		Sensitive
Cherry, ground	Physalis sp.	E.					Resistant
Dandelion	Taraxacum officinale	(½ lb. (1	I III				Very sensitive
Dandelion, fall	Leontodon autumnalis	1½ lb. S & A (½ lb.	III S.A. I				Semi-resistant
Dock, curled	Rumex crispus	(1½ lb. A.E.&S.	III				Very sensitive
Dogbane	Apocynum cannabium	1 lb. A.&E.	II				Sensitive
Evening primrose	Oenothera sp.	½ lb.	I				Very sensitive
False ragweed	Iva ciliata	½ lb.	I				Very sensitive
Fleabanes	Erigeron spp.	½ lb.	I				Very sensitive
Goatsbeard	Tragopogon sp.	½ lb. 2 lb. S.&A.	I III				Very sensitive
Goldenrods	Solidago spp.	1 lb. 2 lbs. S.A.	II III				Sensitive

COMMON NAME	SCIENTIFIC NAME	Formulation used and amount applied per acre	TYPE OF REACTION ACCORDING TO GROWTH STAGE				CLASSIFICATION
			Active growth pre-bud	First Flowering bud	Full Bloom	Fall growth	
Gumweed	Grindelia squarrosa	¾ lb. E.	II				Sensitive
Heal-all	Prunella vulgaris	½ lb.	I				Very sensitive
Hoary vervain	Verbena stricta	1 lb.	II				Sensitive
Horse nettle	Solanum carolinense	1½ lb. A.&E.	III				Semi-resistant
Horse-tail	Equisetum arvense	½ lb. 1¼ lb. A.E.&S.	I III				Very sensitive
Hoary cress	Lepidium Draba	1 lb. A.&E.	II				Sensitive
Lettuce, blue	Lactuca pulchella	½ lb. A.E.&S. 1 lb.	I II				Very sensitive
Licorice, wild	Glycorrhiza lepidota	½ lb.	I				Very sensitive
Milkweed, common	Asclepias syriaca	2½ lb. A.E.S.	IV				Resistant
Milkweed	Asclepias verticillata	1 lb.	II				Sensitive
Moonseed	Menispermum Canadense	½ lb.	I				Very sensitive
Mouse-ear chickweed	Cerastium vulgatum	½ lb.	I				Very sensitive
Mullein, common	Verbascum Thapsus	1 lb.	II				Sensitive

COMMON NAME	SCIENTIFIC NAME	Formulation used and amount applied per acre	TYPE OF REACTION ACCORDING TO GROWTH STAGE				CLASSIFICATION
			Active growth pre-bud	First Flowering bud	Full bloom	Fall growth	
Ragweed, western	Ambrosia psilostachya						Resistant
Rose, wild	Rosa, sp.	1 lb. T. 2½ lb. A.E.&S.	II IV				Sensitive
Sorrel, field or sheep	Rumex acetosella	1 lb. 1½ lb. S.&A.	II III			 III	Sensitive
Sorrel, red	Oxalis acetosella	2½ lb. A.E.&S.	IV				Resistant
Sorrel, wood	Oxalis sp.	2½ lb. A.E.&S.	IV				Resistant
Strawberry, wild	Fragaria americana	1 lb. T. 4 lb. E.	II				Sensitive
Spurge, leafy	Euphorbia Esula	1 lb. A.&E.	II III				Semi-resistant
Sunflowers, perennial	Helianthus spp.	½ lb.	I				Very sensitive
Smartweed swamp or perennial	Persicariacoccinea						Resistant
Sagebrush or wormwood	Artemisia gnaphalodes	1½ lb. 4 lb..	 III				Semi-resistant

COMMON NAME	SCIENTIFIC NAME	Formulation used and amount applied per acre	Active growth pre-bud	First Flowering bud	Full bloom	Fall growth	CLASSIFICATION
Nettle, stinging	Urtica dioica	½ lb.	I				Very sensitive
Night-blooming catchfly	Silene noctiflora						Resistant
Nimble Will	Muhlenbergia Schreberi						Resistant
Ox-eye daisy	Chrysanthemum Leucanthemum	1½ lb. S.&A.	III		III		Semi-resistant
Onion Wild	Allium sp.	2 lb. E.	III				Semi-resistant
Orange hawkweed	Hieracium aurantiacum	2 lb. S.&A.	III		III		Semi-resistant
Plantain common	Plantago major and Rugelii	½ lb. A.E.&S. ¾ lb. E.	I II		II		Very sensitive
Poverty weed	Iva axillaris	1 lb.	II				Sensitive
Parsnip, wild	Pastinaca sativa	1 lb.	II				Sensitive
Roadside thistle	Cirsium discolor	1 lb.	II				Sensitive
Russian Knapweed	Centaurea repens						Resistant
Rosin weed	Silphium sp.	1 lb.	II				Sensitive
Ragweed, burr	Franseria tomentosa	¾ lb. A.T. 1½ lb. E.	II III				Sensitive

COMMON NAME	SCIENTIFIC NAME	Formulation used and amount applied per acre	Active growth pre-bud	First Flowering bud	Full bloom	Fall growth	CLASSIFICATION
Skeleton weed	Lygodesmia juncea	2½ lb. A.E.&S.	IV				Resistant
Toad flax	Linaria vulgaris	4 lb. E.	IV				Resistant
Thistle, Canada	Cirsium arvensis	¾ lb. A.E.S.T.	III	III	III		Semi-resistant
Thistle, per. sow	Sonchus arvensis	¾ lb. A.E.&S. 1½ lb. E.	II III				Semi-resistant
Vervains	Verbena sp. Verbena Stricta	1 lb. 1½ lb. E.	II III				Sensitive Semi-resistant
Vetch, crown	Coronilla varia						Resistant
Vetch, wild	Vicia Cracca	1 lb. S.	II		II		Sensitive
Yarrow	Achillea Millifolium	1 lb. 1½ lb. A.E.&S.	II III		III		Sensitive

(NOTE: The following abstract arrived too late to be mailed to the "perennial plant" chairman so was included here. L.W.M.)

Investigations with 2,4-D for cattail control - Yuma, Arizona. Bowser, Curtis W. Cattail growth (Typha latifolia and T. angustifolia) in 21 miles of main canal was sprayed by airplane on May 4, 1948, with concentration of 1.92 pounds acid equivalent of ethyl ester 2,4-D mixed in water to make 9 gallons total liquid applied per acre. The plants were 3 to 4 feet above water level, growing vigorously, but had not developed seed heads. Spraying suppressed seed development and spread of plants was inhibited; however, only a 25 percent reduction in cattail stand was effected, as small young plants sheltered by the taller growth were not killed. Repeat treatment was made August 23, using 2.48 pounds ethyl ester 2,4-D in water to make 10 gallons total liquid per acre. Cattail density was reduced approximately 30 percent by the two sprayings. Emergent ditchbank vegetation, mostly cattail (T. latifolia) was sprayed early in April 1948 by ground-operated equipment with 4.23 pounds acid ethyl ester 2,4-D mixed in water and applied at rate of 350 gallons liquid per acre. Result was 50 percent kill of plants growing in water, and 80 percent reduction in density of those above water line. Re-treatment at same rate per acre was made August 24, five weeks after burning debris resultant from first 2,4-D spraying. Field counts on September 16 indicated 85 percent reduction in cattail density. Conclusions are that two early spring sprayings--3 to 4 weeks apart but completed before seed head formation--are more effective in controlling cattails than one spring and one fall spraying. Unless 2,4-D product employed is combined with a high percentage of penetrating materials it is advisable to add fuel oil to insure attaining maximum entry of herbicide into cattail leaves. (Contribution of Bureau of Reclamation, U.S. Department of the Interior.)

EFFECTS OF CHEMICAL TREATMENT ON ANNUAL WEEDS

A. H. Larson
Chairman, Committee on Control of Annual Weeds

There is a lack of uniformity in recording the effects of chemical sprays on weedy plants. This is further complicated by a lack of uniformity as to the best time to apply herbicides, the rates, the kinds of chemicals and weeds, and the stage of development of the weed plants.

A questionnaire sent to 142 research workers produced 41 replies. Reports were made on 106 species of weedy plants. The chemicals used were: 2,4-D isopropyl ester, ester, amine, sodium salt and 2,4-D acid in bicarbonate of soda solution, 2,4,5-T, trichloroacetate, sodium salt and wettable powder, borascu, stanisol, pentachlorophenate, sodium salt, pentachlorophenol emulsifiable and isopropyl phenyl carbamate.

In general quantities of the acid equivalent of 2,4-D varied from 1/8# to 1# per acre, with a few going to 2#. Both water and diesel fuel were used as spray mediums. Usually 1 gallon of diesel fuel per acre was used and water varying from 20 to 40 gallons per acre, with a few as high as 300 gallons. In one case, dust preparations of 2,4-D were applied. A few trials were made with chlorate. There was one report each on stanisol, sinox, and trichloroacetic acid and two of pentachlorophenol. The chief chemical used was 2,4-D, and most of this was either ester or amine.

In general the results indicated that a few species of weeds were very resistant to 2,4-D at all stages beyond the early season growth, while others showed resistance only after they approached late summer or fall stages. It is difficult to determine the exact value of spraying at different times because of the rather continuous germinations of seeds through the growing season. In practically no case was a 100% kill reported. If the nature of the reports are typical of all chemical use, the tendency will be to use the amine and esters of 2,4-D in preference to the others and that larger amounts per acre be applied. (Contribution of Minnesota Exp. Sta., St. Paul, Minnesota.)

A SURVEY OF A SEASON OF 2,4-D SPRAYING

Len Weigand

1 Questionnaires were sent to 553 farmers who did spraying with 2,4-D. This abstract reports on the first 100 replies. This represents 20,877 acres of crop lands. It shows 90% sprayed grains, 48% corn, and 18% legumes, also that 15% reported increased yields, 28% no increase, and 13% made no comment. In this 97% reported no signs of damage and 3% slight damage. Nine percent had difficulty in preparing solutions in water. In addition, 83% said they would do more spraying in 1949 and 17% about the same as this year.

The tendency was to plan using a stronger solution next year on cereals except barley. Farmers who did custom spraying in 1948 will do less in 1949 and weed spraying will become a home farm practice. Dinitros appear to be passing out except where young legumes are concerned and 2,4-D use on flax will increase. Spraying 2,4-D eliminated some of the difficulties in harvesting. (Contribution by Associated Dealers Supply, Willmar, Minnesota.)

EFFECTS OF GROWTH SUBSTANCES IN CONTROLLING PURSLANE (PORTULACA OLERACEA)

K. P. Buchholtz

2 The sodium salt (1), amine (2), and butyl ester (3) of 2,4-D as well as the isopropyl esters of 2,4,5-T (4) and MCP (5) were applied to emerging purslane seedlings. Applications were made at the rates of 0.25, 0.5 and 1.0 pounds per acre of the acid equivalent using 20 gallons of water. Treatments were replicated four times and the data were analyzed statistically. Weed counts one month after application showed that some treatments had given excellent control of the purslane. All treatments but the 0.25 and 0.5 pound applications of (1) and the 0.25 pound applications of (2) reduced plant numbers significantly. The average weed infestation for plots receiving treatments with (1), (2), (3), (4), and (5) were 15.2, 8.4, 1.3, 3.9 and 5.5 plants per square foot with check plots averaging 19.9 plants. There was no statistical difference between average plant coun obtained with (3), (4) and (5) although (3) gave the lowest plant counts at every rate of application. In this study the 0.25 pound application of (3) was greatly superior to the 1.0 pound application of (1) and superior to the 1.0 application of (5) and the 0.5 applications of (2) and (4). (Contribution of the Dept. of Agronomy, University of Wisconsin, Madison, Wisconsin.

CONTROL OF CRABGRASS WITH CHEMICALS

F. W. Slife

3 The following chemicals and combinations of chemicals were used on crabgrass (Digetaria sp.) growing in bluegrass (Poa pratensis) to test their effectiveness as crabgrass killers. I.P.C., I.P.C. and 2,4-D, phenyl mercuric acetate, phenyl mecuric acetate and 2,4-D, I.P.C. and phenyl mercuric acetate, trichlorcacetate, arsenic acid, and arsenic acid and 2,4-D. The plots were in an area that had been mowed regularly. The chemicals were applied in August and the bluegrass was still in an active growing state because of frequent rains throughout the summer. A difference was evident in the response of bluegrass and crabgrass to these chemicals; the crabgrass was more susceptible. The most effective control of crabgrass was obtained with phenyl mercuric acetate mixed with 2,4-D. Counts indicate as high as 90 percent control of crabgrass with this mixture, but bluegrass was injured to some extent. Arsenic acid in these tests destroyed the top growth of crabgrass and caused some injury to bluegrass from which it eventually recovered. (Contribution of Ill. Agr. Exp. Sta.)

USE OF 2,4-D IN THE CONTROL OF WHEAT AND FLAX

D. A. Brown

4 Two acre blocks of each crop were seeded on weed infested land. Formulations employed were ester, amine and sodium salt. Ester was applied at 1, 2 and 4 ounces of acid per acre; amine at 1½, 3 and 6 ounces, and sodium salt at 2, 4, and 8 ounces per acre. Wheat was sprayed at 6" high and flax at 4". Fairly heavy infestations of stinkweed, Russian thistle, common buckwheat, pigweed and green foxtail were present and light infestations of false ragweed, night-flowering catchfly and night-shade. Ester at 4 ounces killed over 90 percent of stinkweed and set back slightly the normal growth of Russian thistle and common buckwheat, but left all other existing weeds uninjured. Later in the season Russian thistle havily infested the crop. The highest rate of amine and sodium salt killed 40 percent of the stinkweed, but left all other weeds present relatively unharmed. The two lower rates of all formulations gave practically no killing of any of the weeds present. In wheat the sodium treated plots gave significantly lower yields than the other two formulations. Ester and amine plots were comparable with those from untreated plots. (Contribution by Field Husbandry Division. Dominion Experimental Farm, Brandon, Manitoba.)

5 Annual weed control in the winter wheat belt. Phillips, W. M. Experiments involving five different stages of wheat growth and observations made in commercially sprayed fields of wheat afforded the opportunity for studying the effect of 2,4-D on various annual weeds at almost every conceivable stage of weed growth. Without exception, all susceptible weeds were more easily killed at early stages of growth. There appeared to be little difference between the butyl, methyl, or isopropyl ester when applied by airplane in a diesel fuel carrier. Five gallons of water was necessary to give adequate coverage when applied by airplane. Nearly twice as much amine was necessary to give results comparable to the esters, and the sodium salt was even less effective. Excellent weed control resulted from applications made while the weeds were small, with results becoming less satisfactory as weeds approached maturity. 2,4-D and dinitro compounds have not been satisfactory substitutes for cultivation in a summer fallow program. The dinitro application have been only moderately successful in eradicating annual grasses and volunteer grain. Chemicals are rapidly coming into prominence as valuable tools in a well rounded farming program in the hard winter wheat area. (Contribution of Bureau of Plant Industry, Division of Cereal Crops and Diseases, Hays, Kansas.)

PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS

Investigation III-6. Use of 2,4-D as a Selective Herbicide in Controlling Weeds in Legumes Seeded with Wheat, Oats or Barley. Investigation leader: John H. Miller

Regional Summary

From a rather limited amount of data, it appears that legumes seeded as undercrops to cereal crops may, in most cases, be safely treated with applications of 2,4-D up to and including concentrations of 1/4 pound of acid per acre provided the nurse crop is dense and has reached a height of approximately 20 inches. The density and size of the nurse crop appear to be a very important factor in the response of legumes seeded as undercrops to 2,4-D applications.

In general, the ester formulation of 2,4-D caused more damage to legumes than the amine and sodium salts. The sodium salt appeared to be least severe in its reaction.

Bucholtz found red clover to be more tolerant to 2,4-D than alfalfa. Miller could observe little difference in the tolerance displayed by red clover and biennial sweet clover. In most cases, the legumes seeded in cereals appear to be more susceptible to 2,4-D when the legume and nurse crop are small.

As very little data were presented on the response of weeds in these experiments, little can be said about weed control. Leefe reports effective control of wild radish with 2, 4, 8 and 12 ounces of 2,4-D per acre. Miller on the other hand did not satisfactorily control small ragweed, cocklebur, and lambsquarter with concentrations of 1/4 pound of 2,4-D acid per acre. Undoubtedly the variation in weather was an important factor in causing the differential response observed in these trials by the various workers.

PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS

Abstracts of Results of Individual Cooperators.

Investigation III-6. Use of 2,4-D as a Selective Herbicide in Controlling Weeds in Legumes Seeded With Wheat, Oats or Barley

1 Response of Red Clover and Alfalfa Seedlings in Oats to Three Preparations of 2,4-D Applied at Several Rates. Buchholtz, K. P. Sodium salt, amine and butyl ester preparations of 2,4-D were applied to medium red clover and Ranger alfalfa seedlings at rates of 0,25, 0,50, 1.0 and 2.0 pounds per acre of the acid equivalent with water equal to 20 gals. per acre. The butyl ester preparation was applied at an additional rate of 0.125 per acre. Clinton oats was used as the companion crop and was approximately 20 inches high at the time of application, with abundant foliage. Four replications of all treatments were made and the data were analyzed statistically. Legume counts were made in the fall after several months of recovery. Untreated check stands of red clover averaged 8.4 plants per sq. ft. None of the sodium salt applications reduced the clover stands. The 2 pound application of the amine reduced the stand to 60 per cent of check, the lower amine applications having no significant effect. The 1.0 and 2.0 pound per acre application of the butyl ester reduced stands to 44 and 6 per cent of check. The lower rates of application had no appreciable effect. Check stands of alfalfa averaged 8.8 plants per sq. ft. Sodium salt applications of 1.0 and 2.0 pounds reduced stands to 68 and 46 per cent of check. The 0.25 and 0.50 pound rates had no significant effect. Amine applications of 0.5, 1.0 and 2.0 pounds reduced stands to 73, 73 and 42 per cent of check respectively, the 0.25 rate having no effect. Butyl ester applications of 0.5, 1.0 and 2.0 pounds reduced stands to 37, 11 and 0 per cent of check. The 0.125 and 0.25 pound per acre applications had little effect. It is evident that red clover is more tolerant of 2,4-D than alfalfa. However, both may be maintained if sufficiently low rates of 2,4-D application are used and a good grain foliage cover is available. (Dept. Agronomy, Univ. of Wisconsin, Madison, Wisconsin).

2 Effect of 2,4-D and Dow Selective as Selective Herbicides on Legumes Seeded with Oats. Taylor, D. K. During 1948 applications of three formulations of 2,4-D at various concentrations and one treatment with Dow Selective were applied to square rod plots of drilled oats seeded to red clover. Severe lodging and poor harvesting weather prevented any estimation of the oat yields. A plant count of square yard areas in each plot showed considerable reduction in the clover stand of the treated areas in comparison to the check. Average results show that the red clover survival ranged from 40.9 per

cent. for the sodium salt at 1/4 pound per acre to 5.5 per cent. for the ester at 1 pound per acre. The amine and ester salts were each in turn more severe than the sodium salt in their effect on the clover survival. The Dow Selective treatment at 3 pints per acre averaged 26.6 per cent. survival which was comparable to the results from the ester at 1/4 pound, the amine at 1/2 pound and the sodium salt at 3/4 pound per acre. (Contribution of the Dom. Exp. Farm, Agassiz, B. C.)

3 Spraying Grain Crops Containing Legume Seedings. Slife, F. W., R. F. Fuelleman. Oat and wheat fields with legume seedings have been sprayed with all three formulations of 2,4-D. 1/4 pound of acid was fatal to legume seedlings when the nurse crop was from 8 to 12 inches tall. Applications of either 1/2 pound acid of sodium salt, 1/4 pound acid of ester or 3 quarts of dynitro selective material per acre to wheat that was 2 1/2 to 3 feet fall resulted in about 50 per cent kill of the clover seeding. Our work indicates that when 1/4 pound of acid or more is used on small grains with a legume seeding the injury will vary with the amount of protection offered to the seeding by the nurse crop. (Contribution of Ill. Agr. Exp. Sta.)

4 Response of Red Clover and Biennial Sweet Clover to 2,4-D when Seeded as Undercrops to Mindo Oats. Miller, John H. Sodium salt, triethanolamine salt and isopropyl ester preparations of 2,4-D were applied to red clover and biennial sweet clover seeded in Mindo oats. The herbicides were applied at 1/16, 1/8, and 1/4 pound of acid per acre. The plots were sprayed when oats were in the tillering stage, shooting stage, heading stage and after the oat crop had been harvested. The results obtained were, in general, very poor. The expected responses were not evident, since there appeared to be little difference in concentrations, dates, or formulations. An average of treated plots compared to untreated plots showed a slight reduction in stand of legumes. The sodium salt gave results indicating 1/16# of acid per acre gave no response except in the fall. In general 1/8 and 1/4 pound gave slightly increased damage to the legume except in the fall. With the sodium salt the greatest decrease in stand was in the tillering and after-harvest treatments. The response of amine salt tends to follow the same trend for dates of application; however the response to rates was so inconsistent that no logical conclusion could be drawn. The response of the ester could not be explained in any logical manner.

The plot area was infested with small ragweed, lambsquarter, and cocklebur. No treatment gave effective weed control. Examination of the root system of these weeds showed a considerable amount of abnormal roots; however most of the plants matured and produced seed.

It is thought that the abnormally dry conditions that prevailed were in part responsible for the poor results obtained in these trials. (Contributions of U.S.D.A., D.P.I. and Division of Agronomy and Plant Genetics, University of Minn.)

8 Use of 2,4-D as a Selective Herbicide in Controlling Weeds in Red Clover Seeded with Oats. Leefe, J. S. Sodium salt, amine salt and ester at 2, 4, 8 and 12 ounces per acre rate was sprayed on red clover seeded down with oats. Sprays applied at shooting stage and heading stage of oats, red clover in seedling and 3 to 5 leaf development, respectively. Field infested with wild radish (Raphanus Raphanistrum). With early spray satisfactory stands of clover were obtained with sodium salt at 2 and 4 ounces per acre rate, with amine at 2 ounces per acre. Other treatments very materially reduced the stands of clover. Control of wild radish was satisfactory at all rates. The late spray resulted in poor stands of clover and unsatisfactory weed control. (Contribution of Dominion Experimental Station, Kentville, Nova Scotia)

6 Response of Red Clover and Alfalfa Seedlings to Growth Regulator and Dinitro Herbicides. Buchholtz, K. P. Seedlings of medium red clover and Ranger alfalfa growing with Clinton oats as a companion crop were sprayed when the oats was about 24 inches high. The following 2,4-D preparations were applied at the rate of 1 pound of the acid equivalent per acre using 20 gallons of water: (1) ethyl ester, (2) isopropyl ester, (3) butyl ester, (4) sodium salt, (5) ammonium salt, (6) Dow Chemical Co. amine preparation, (7) John C. Powell and Co. amine preparation, (8) American Chemical Paint Co. amine preparation. In addition the isopropyl ester of 2,4,5-tri chlorophenoxyacetic acid (9) and the isopropyl ester of 2-methyl, 4-chlorophenoxyacetic acid, (10) were applied at the equivalent of 1 pound of the acid per acre. A 13 per cent preparation of ammonium salt of dinitro-o-sec-butyl phenol was applied at the rate of 1 gal. per acre in the equivalent of 80 (11), 40 (12) and 20 (13) gallons of water. All applications were replicated four times and the data were analyzed statistically. Check stands of red clover and alfalfa averaged 6.6 and 6.8 plants per square foot respectively. Significant reductions in stands of red clover were obtained following applications of (1), (2), (3), (7) and (9). Stands obtained were respectively, 11, 30, 17, 16 and 4 per cent of check for these applications. Plots treated with (10) had significantly better stands than check, being 144 per cent of check. All other treatments were not significantly different from check. Significant alfalfa stand reductions were obtained following applications of (1), (2), (3), (5), (6), (7), (8), (9), and (10), the stands as per cent of check being 3, 11, 6, 67, 53, 24, 23, 10, and 13 respectively. The dinitro sprays significantly increased the stands of alfalfa, the stands being 157, 154 and 143 per cent of check for applications (11), (12) and (13) respectively. (Dept. of Agronomy, Univ. of Wis., Madison, Wisconsin)

PROJECT III. EFFECTS OF 2,4-D AS A SELECTIVE HERBICIDE ON GROWING CROPS

Spring Wheat, Oats and Barley Investigation leader: Lyle A. Derscheid

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Twenty-seven abstracts, twenty-three of which were accompanied by tabular data, were received. These summaries report the effect of 2,4-D on fifteen varieties of oats, seventeen varieties of barley and thirteen varieties of wheat. Such factors as yield, viability of seed, kernel weight, maturity, malformations, and strength of straw are discussed. Since yield is undoubtedly, the most important single factor, the accompanying table has been made, showing the maximum amount of 2,4-D reported by each investigator, that has been applied to each variety at various stages of growth without depressing the yield.

Oats

Oat yields indicate that this crop is more susceptible at early stages of growth than at later stages. Thirteen varieties were treated when 3 inches tall or in 3-leaf stage of growth. At least one report for each of eleven varieties indicated that 1 pound of 2,4-D acid in the amine or sodium salt form could be applied without reducing the yield. It was reported that 3/4 pound of either salt could be applied to Eagle at this stage, but 1/8 pound of the amine was the highest recommendation made for Exeter. Derscheid, Stahler and Kratochvil indicate the 1 pound rate of either salt may be applied to Clinton at this stage without reducing the yield, but Shaw and Willard indicate that 1 pound of all three formulations may be used. Derscheid, etal report that 1 pound of either salt may also be applied to Mindo, Bonda, Richland, Tama, Vikota, Brunker, Trojan and Marion when 3 inches tall without reducing the yield. Friesen reports that 1 pound of ester or either salt may be applied to Ajax in the 3-leaf stage without decreasing the yield. Godbout agrees that 1 pound of amine may be used but reports a reduction in yield if over 1/2 pound of ester is used. He also feels that Ajax is more sensitive than Erban. Davidson obtained a yield reduction when Ajax was treated in the 3-leaf stage with as little as 2 ounces of ester or sodium salt and when more than 2 ounces of the amine were used. Freisen also reports no yield decrease in Ajax when treated with 1 pound of each formulation at 5-leaf stage. Godbout indicates that the yield of Erban was not reduced with 1 pound of ester and amine in two experiments and 1 pound of sodium salt in one experiment when treated at the 3-leaf and 5-leaf stages. Leggett, who feels that oats is the most susceptible of the three crops, obtained yield reductions in Eagle when over 1/2 pound ester or 3/4 pound of either salt were applied at 3-leaf stage and when over 1/4 pound ester or amine or 3/4 pound sodium salt was applied to 5-leaf stage. Davidson reports yield reductions when as little as 2 ounces of ester or sodium salt and over 2 ounces of amine, were applied to Exeter at 3-leaf stage, but Olson and Zalik report no reduction in yield at 4-5 inch stage when 1/2 pound of ester or 1 pound of either salt is used. Carder tested Victory and reports that 3/4 pound of ester or amine and 1 pound of sodium salt may be applied when the crop is 4-8 inches tall without lessening the yield.

Shaw and Willard report that 4 pounds of the ester and amine were applied to Clinton oats that was 6-8 inches tall without decreasing the yield. Goodwin, Slife and Fuelleman indicate that no damage was done to Clinton 11 and Mindo when treated with 1/2 pound of sodium at the same stage.

Derscheid, Stahler and Kratochvil report that 1 pound of ester reduces the yield of Clinton, Mindo, Bonda, Richland, Tama, Vikota, Brunker, Trojan and Marion when applied to grain 12 inches tall and fully tillered, but that a like amount of the amine and sodium salts do not decrease yields at this stage.

Freisen applied 1 pound of each formulation to Ajax and Godbout applied the same amount of each formulation to Erban when the crop was in the shot-blade stage of growth without a significant yield decrease. Leggett, however, treated Eagle at this stage and obtained yield reductions when over 1/4 pound ester or amine and over 3/4 pound sodium was applied.

Olson and Salik treated Ajax 5 days after heading and Exeter 3 days after heading, while Derscheid, Stahler and Kratochvil treated Clinton, Mindo, Bonda, Richland, Tama, Vikota, Brunker, Trojan and Marion while heading and again after fully headed with 1 pound of each formulation. Shaw and Willard used 1 pound of the ester and amine at eight dates from emergence to milk (some of which undoubtedly occurred during heading). None of these treatments caused significant decreases in yield. Buchholtz treated Clinton when starting to head with 1 pound of each 2,4-D formulation without reducing yields, but did obtain yield reductions with a 13% preparation of dinitro-o-sec-butylphenol mixed in 80, 40 and 20 gallons of water per acre.

Shaw, etal and Derscheid, etal, report that the ester caused a twisting of leaves "onion leaf" when applied at early stages. Carder reported blasted panicles and miniature kernels of Victory when 16 ounces of Amine and 4 or more ounces of ester were applied to grain 4-8 inches tall. Almost all of the investigators report a delay in maturity of 2-5 days after 2,4-D has been applied to the earlier stages of growth. Some investigators report that the straw is shorter on treated plots.

Goodwin etal, Buchholtz and Derscheid etal report that the viability of seed produced from treated plants with 2,4-D is not affected. Buchholtz and Derscheid etal report that kernel-weight of seeds from oat plants treated with 2,4-D is not affected. Buchholtz, however, did obtain a significant decrease in kernel weight of oats that was treated with dinitro-o-sec-butyl-phenol.

Barley

The yields of barley indicate that barley is affected much the same as oats. Of the seventeen varieties reported, twelve have been treated when 3 inches tall or in 3-leaf stage of growth. The first seven varieties, in the attached table, Plains, Feebar, Odessa, Spartan, Wisconsin #38, Manchuria, Kindred and Tregal have been tested two years, by Derscheid, Stahler and Kratochvil. Each year yields have been reduced by applying 1 pound of each formulation when the grain was 3 inches tall. Davidson reports that yields of Montcalm were not reduced by applying 1/2 pound of the ester or either salt at the 3-leaf stage and Olson and Zalik report no reduction with 3/4 pound of ester applied when the crop was 2½ to 10 inches tall, but do report a depressed yield from applications made when the grain was 1 inch tall and when 2 inches tall. Corns states that 1/2 pound of either formulation does not decrease yields of Olli when treated at the 3-leaf stage and Leggett reports that 1 pound of either formulation does not depress the yield of Olli,

at the 3-leaf or the 5-6 leaf stage. Friesen indicates that yield of Titan is not depressed with 1 pound of either of the three formulations when applied at either the 3-leaf or 5-leaf stage. Davidson reports that 3/4 pound of either of the three formulations is the maximum that can be applied to Vantage at the 3-leaf stage without reducing yields and Olson and Zalik feel that 1/2 pound ester and 1 pound of either salt will not reduce the yield if applied when Vantage is 4 to 5 inches tall.

Olson and Zalik report that 3/4 pound of ester does not reduce the yield of Montcalm if applied when the crop is fully tillered and Derscheid, Stahler, and Kratochvil indicate that 1 pound of either the amine or sodium salt may be applied at this stage to Feebar, Odessa, Spartan, Wisconsin #38, Manchuria, Kindred or Tregal without depressing yields.

Three investigators reported treatments made at the shot-blade stage of growth. Leggett treated Olli and Friesen treated Titan. Each reported no yield reduction with 1 pound of either formulation. Olson and Zalik also reported no depression in yield when they treated Montcalm with 3/4 pound of ester.

The late boot stage seems to be the most susceptible stage of growth as Olson and Zalik obtained a reduction in yield with 3/4 pound of ester 4 days before heading, and Bohmont depressed the yields of Club Mariout with 1/2 pound of either formulation when spikes were emerging. However, the yield of Lico was not decreased when Bohmont applied 1/2 pound of each formulation as spikes were emerging. Likewise, Corns reports that the yields of Olli was not reduced by applying 1/2 pound of ester when spikes were emerging.

After the grain had started to head, Derscheid, Stahler and Kratochvil made two treatments to Plains, Feebar, Odessa, Spartan, Wisconsin #38, Manchuria, Kindred and Tregal. One pound of either the amine or sodium salt did not decrease yields at either date. Montcalm and Vantage were treated by Olson and Zalik five days after heading. One pound of each formulation failed to depress yields. They also treated Montcalm at 3 day intervals from 4 days before heading until 18 days after heading with 3/4 pound of ester. Yields were reduced by treating 4 days before heading, 1 day before heading and 2 days after heading. Sexsmith, however, treated Glacier, Trebi, Compana, Montcalm, Olli and Titan when 90% headed. He reports that if more than 2 ounces of ester or 8 ounces of amine were used, the yield was reduced. He did not use the sodium salt.

Deformed heads were reported by Leggett, and Derscheid, etal, from treating at the 3-leaf or 3 inch stages of growth. Freisen and Davidson reported that off type heads were not noted in Titan, Vantage and Montcalm when treated at the 3-leaf stage.

The straw strength was measured by Brown who reported that the higher rates decreased the strength of the straw and that the sodium salt decreased the strength the most, followed by the ester and amine.

Corns reported that the higher the rate of application of 2,4-D, the lower the protein content except where the yield was decreased by more than 5 bushels per acre, then the protein content increased slightly. Corns also noted that the maturity of Olli was delayed 2-5 days when 12 ounces of the ester was applied.

Wheat

Of the thirteen varieties tested, only four were treated at early stages. Legget reports that 1/2 pound ester or amine and 1/8 pound sodium may be applied to Thatcher at 3-leaf stage, but 1/4 pound ester and sodium and 1/2 pound amine may be applied to the 5-6 leaf stage without depressing yields. Foster, however, feels that 1/2 pound of either formulation can be used at either stage and Davidson indicates that 3/4 pound of either formulation may be used at 3-leaf stage and 1 pound of either formulation may be used at 5-leaf stage without reducing yields. Friesen reports that 1 pound of the ester or either salt does not reduce yields of Rescue when applied to the 3-leaf and 5-leaf stages. Davidson, however, indicates that 1 pound of sodium does not depress the yield of Redman at the 3 leaf-stage, but it is possible that 1 pound of the ester or amine will. Olson and Zalik indicate that Redman may be treated with 1/2 pound ester and 1 pound of either salt when 4-5 inches tall and that Stewart may be treated at the same stage with 1 pound of each formulation without depressing yields.

Bohmont treated Thatcher and Ficht treated Regent and Stewart while tillering. Bohmont indicates that 1/2 pound of each formulation may be applied to Thatcher. The highest rates used by Ficht were 4 ounces of ester, 6 ounces of amine and 8 ounces of sodium, but yields were not depressed by any treatment.

The Reported Maximum amount of the three main 2,4-D Formulations that can be applied to Several Varieties of Spring Grain without depressing the yield (Summary of 27 abstracts).

OATS

Variety	Stages of Growth: Emerg.	3-leaf 3-inch	5-6 leaf 4-5 inch	Tiller. 6-8 in.	Fully Till.	Shot blade	Shoot heads	Fully Head.	Abstract number
Clinton	1EA	1EAS*		4EA	1AS*		1EAS	1EAS	7,8,9,10,11
Clinton 11				½ S					9
Mindo		1AS*		½ S	1AS*		1EAS	1EAS	9,11
Bonda		1AS*			1AS*		1EAS	1EAS	11
Richland		1AS*			1AS*		1EAS	1EAS	11
Tama		1AS*			1AS*		1EAS	1EAS	11
Vikota		1AS*			1AS*		1EAS	1EAS	11
Brunker		1AS*			1AS*		1EAS	1EAS	11
Trojan		1AS*			1AS*		1EAS	1EAS	11
Marion		1AS*			1AS*		1EAS	1EAS	11
Ajax		½E1A*					1EAS		15, 32
		1EAS	1EAS	¼E;½S		1EAS			29,30
		1/8A*		3/8 A					30,31
Erban		1EAS	1EAS			1EAS			14
		1EA*							15
Exeter		1/8A*	½E;1AS*				1EAS		31,32
Victory			3/4EA1S*	3/4EA;1S*					12
Eagle		½E3/4AS*	1/4EA;3/4S*			¼EA;3/4AS*			13

(CONTINUED)

BARLEY

Variety	Stages of Growth: 3-leaf 3-inch	5-6 leaf 4-5 inch	Till. 8 in.	Fully Till.	Shot Blade	Spikes emerg.	25-90% headed	Fully head.	Abstract number
Plains	1EAS-			1AS*			1AS*	1AS*	19
Feebar	1EAS-			1AS*			1AS*	1AS*	19
Odessa	1EAS-			1AS*			1AS*	1AS*	19
Spartan	1EAS-			1AS*			1AS*	1AS*	19
Wisc.#38	1EAS-			1AS*			1AS*	1AS*	19
Manchuria	1EAS-			1AS*			1AS*	1AS*	19
Kindred	1EAS-			1AS*			1AS*	1AS*	19
Tregal	1EAS-			1AS*			1AS*	1AS*	19
Glacier							1/8E½A*		33
Trebi							1/8E½A*		33
Compana							1/8E½A*		33
Montcalm	½EAS		1EAS				1/8E½A*		18, 31, 33
	3/4E	1EAS	3/4E	3/4E	3/4E	3/4E	1EAS	3/4E	32,33
Olli	½ E		3/4E*			1/2E*	1/8E½A*		16,33
	1EAS	1EAS			1EAS				17
Titan	1EAS	1EAS	¼E3/8A½S		1EAS		1/8½A*		29,30,33
Vantage	3/4EAS*	½E1AS*	1EAS				1EAS		18,31,32
Lico						½EAS*		1EAS	20
Club Mariout						½EAS-		½ES;1A	20

WHEAT

Variety	Stage of growth: 3 leaf	5-6 leaf 4-5 inch	Tillering	Fully till.	Shot blade	Boot	Heading	Headed	Abstract number
Thatcher	½E&A1/8 S*	½ES½A*	½EAS	1EAS	1/8AS*	1EAS		1EAS	21,23,24
	½EAS	½EAS					½E;3/4A*		25,33
	3/4EAS	1EAS					½E;1AS*		31,32
Mida				1EAS		½EAS-			22,23
				1EAS		½EAS-		1EAS	24
Rival				1EAS					23
Pilot				1EAS					23
Regeant				1EAS					23
Rescue	1EAS	1EAS	¼E3/8A½S				½E;3/4A*		29,30,33
Redman	1S*	½E1AS					½E;3/4A*		31,33
		1EAS					½E;1AS*		32
Saunders							½E;3/4A*		33
Lemhi							½E;3/4A*		33
Marquis							½E;3/4A*		33
Mindum				1EAS					23
Carleton				1EAS					23
Stewart		1EAS	¼E;3/8A;½S				½E;1AS		30,32

* Higher rates of application were tested or other formulations were tested which decreased yields.

\- Lowest rate of application reported by investigator but yields were reduced.

E. - Ester; A. - Amine; S. - Sodium salt of 2,4-D expressed in pounds of 2,4-D acid per acre.

Seven varieties were treated while fully tillered. Helgeson indicates that Thatcher, Mida, Regent, Rival, Pilot, Mindum and Carleton are tolerant of 1 pound of each formulation at this stage.

Bohmont indicates that Thatcher is tolerant of 1 pound of each formulation but that the yield of Mida is reduced by 1/2 pound of each formulation while in the boot stage of growth. Helgeson concurrs in that 1/2 pound of each formulation reduces the yield of Mida at this stage.

Seven varieties were treated while heading. Sexsmith reports that the yields of Saunders, Redman, Thatcher, Marquis, Rescue and Lehmi are reduced if more than 1/2 pound ester or 3/4 pound amine is applied at this stage. He did not apply the sodium salt. Olson and Zalik agree that more than 1/2 pound of ester will reduce yields of Thatcher and Redman 10 days after heading and also Stewart 2 days after heading, but they report that 1 pound of either the amine or sodium salt does not reduce the yields of these varieties at this stage.

Bohmont applied one pound of each formulation to Thatcher and Mida after they were fully headed without reducing yields.

Deformed heads were reported on treated plots by Leggett, Foster, Davidson, and Wood and Bourns when the grain was treated in 3-leaf stage.

Helgeson reports a depressed test weight and kernel weight of Mida treated in the boot. He also reports that this treatment caused lodging.

Helgeson and Davidson report shorter straw and delayed maturity on plots treated with 2,4-D.

Summary

Leggett believes that oats is the most susceptible crop followed by wheat, with barley being the most tolerant. The data presented in these abstracts, however, indicate that oats is the most tolerant followed by wheat and barley. There appears to be more varietal difference in barley than either of the other crops and this crop seems to be less tolerant of the ester formulation than other formulations.

These data indicate that oats can be treated with 3/4 to 1 pound of either salt at any stage reported and that a comparable amount of ester may be used after the crop is fully tillered. A similar amount of either salt may be applied to barley after it is fully tillered -- except when spikes are emerging -- but less of the ester should be used. Heavy rates of application (3/4 to 1 pound) tend to decrease barley yields when applied before the crop is fully tillered with the exception of a few varieties. Wheat has not been tested as extensively as either oats or barley, but these data indicate that it reacts much the same as barley. It does, however, appear to be more tolerant to the ester formulation than barley. Like barley, it is quite susceptible when in the boot.

PROJECT III. EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS

Abstracts of Results of Individual Cooperators

Spring Oats, Wheat and Barley

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7 The effect of 2,4-D on Clinton oats at Columbus, Ohio. Shaw, Warren C. and C. J. Willard. Clinton oats were treated at emergence, (April 24) and at 8 later dates, ending July 9 at the milk stage, with the triethanol amine salt and the butyl ester of 2,4-D at 1/4, 1/2, and 1 pound per acre, acid equivalent. The experiment was a randomized block design with 3 replications. The plots were 10' x 40'. The 1 pound rates caused considerable visible injury, such as twisting and "onion leaf", but the yields were not significantly reduced by any rate of any material on any date. The greatest injury was caused by treatments at emergence and one and two weeks later. No lodging was caused by any treatment on this very poor and non-uniform soil. The butyl ester, when applied at 1 pound per acre after the oats had jointed, delayed maturity for 3 to 5 days. The butyl ester gave better control of weeds, especially at the 1/4 and 1/2 pound rates, than the amine salt. Annual weeds were of minor importance in this experiment, but dogbane and Canada thistle occurred in about half of the plots. (Contributed from the Ohio Agr. Exp. Sta.)

8 Effect of 2,4-D on yield of Clinton oats at pre-joint stage, Columbis, Ohio. Shaw, W. C. and C. J. Willard. Clinton oats sown April 14 were treated May 11, when 6" to 8" high to tip of extended leaf,,with the triethanol amine salt, sodium salt, and butyl ester of 2,4-D at 1/2, 1, 1 1/2, 2 and 4 pounds per acre acid equivalent. The test was a randomized block design, with three replications. The plots were 10' x 40'. The yields of the treated plots did not differ significantly from closely agreeing untreated checks. Weeds were not a factor in the yields. However, the plots treated with 4 pounds per acre in the butyl ester formulation were visibly injured, and the yield reduction on these three plots approached significance. No other treatments were visibly affected, or showed any differences in yields. (Contribution from the Ohio Agricultural Experiment Station)

9 Spraying oats with 2,4-D. Goodwin, H* F. W. Slife, and R. F. Fuelleman. Three varieties of oats, Mindo, Clinton and Clinton 11, were treated in May with 1/2 pound acid in the form of the sodium salt of 2,4-D. The oats were approximately eight inches tall. In the treated plots, 100 percent control was obtained on a very heavy infestation of annual weeds in the 4,and 6 leaf stage of growth. Comparative yields in bushels per acre were as follows: Mindo, sprayed 76.7 bus. Mindo, unsprayed, 73.0 bus.; Clinton 11, sprayed 83.4 bus.; Clintonll unsprayed 71.0 bus.; Clinton sprayed 87.4 bus.; Clinton, unsprayed 77.1 bus. In all cases, the height of the mature grain was taller in the sprayed plots. Germination tests on the grain from all plots shosed no reduction in percent of germination due to treatment. (Contribution of Illinois Agr. Exp. Sta.)

*Funk Bros. Seed Co.

10 Effect of herbicidal applications of growth regulating substances and dinitro materials on the grain yield, seed germination, spikelet number and kernel weight of oats. K. P. Buchholtz. Clinton oats was treated when approximately 24 inches tall and starting to head with 2,4-D as the ethyl ester (1) isopropyl ester (2) butyl ester (3) sodium salt (4) ammonium salt (5) Dow Chemical Co. amine (6) J. C. Powell and Co. amine (7) and the American Chemical Paint Co. amine (8) at the rate of 1 pound of the acid equivalent per acre using 20 gallons of water per acre. The isopropyl esters of 2,4,5-T (9) and MCP (10) were applied at similar rates. A 13 per cent preparation of dinitro-O-sec-butylphenol was applied at the rate of 1 gallon per acre in 80 (11), 40 (12) and 20 (13) gallons of water. All treatments were replicated four times

and the data were analyzed statiscally. The experimental area was kept essentially weed free throughout the season except for a seeding of red clover and alfalfa. Applications (3), (11), (12), (13), reduced grain yield significantly. Plots receiving these treatments yielded 93.4, 92.7, 67.5 and 64.8 bushels per acre while check yielded 108.2 bushels. None of the other plots yielded significantly different from check. Seed from the treated plots germinated from 91.4 to 97.7 per cent while seed from check plots germinated 97.4 per cent. None of the differences are significant. None of the growth substance applications reduced kernel weight significantly but the dinitro applications (11), (12), and (13) reduced kernel weights to 2.36, 2.05 and 1.93 gms. per 100 kernels while check weighed 26.5 gms. All of these reductions are significant and are thought to be due to severe difoliation produced by these sprays. Average spikelet numbers per panicle were determined for all treatment but none significantly different from check. (Dept. Agronomy, Univ. of Wis. Madison Wis.)

11 The effect of 2,4-D formulations on yield and viability of oats when applied to one variety at three stages of growth in 1946 and when applied to nine varieties at four stages of growth in 1947 and 1948 at Scotland, South Dakota Derscheid, Lyle A., L. M. Stiller and D. E. Kratochvil. Duplicate square rod plots of Richland oats were treated with the butyl ester and the triethanolamine, ammonium and anhydrous sodium salts of 2,4-D at the rate of 1.3 pounds of 2,4-D acid per acre when the crop was heading, fully headed and in dough in 1946. Triplicate 4 x 12-foot plots of Clinton, Bonda, Mindo, Richland, Tama, Vikota, Brunker, Trojan and Marion were treated with the butyl ester and the triethanolamine and monohydrate sodium salts in 1947 and 1948. Yield and viability data were analyzed statistically each year. Although significant differences in yields of the nine varieties were obtained, they all responded alike to the various 2,4-D formulations at all 4 stages of growth. Significant changes in yield due to treatment at the various stages of growth was not established either year. Significantly higher yields were obtained from plots treated with the ammonium salt of 2,4-D in 1946 and significantly lower yields were obtained from ester treated plots in 1948 - no difference was established in 1947. A significant "F" value for "treatment x stages" in 1947 was caused by the significantly low yields from plots treated with the ester at the fully tillered stage of growth and the significantly high yields from plots treated with the sodium salt at the seedling stage. The significant "F" value for "treatment x stage" in 1948 was caused by the significantly low yields obtained from plots treated with the ester at the two earlier stages. The viability of oats was not affected any year. This study indicates no significant reduction of yield and viability of nine oat varieties when treated with 1 pound 2,4-D acid per acre at the indicated stages of growth, except for the reduced yields from plots treated with the ester at the fully tillered stage in 1947 and 1948 at and the seedling stage in 1948. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry Soils and Agricultural Engineering USDA).

12 The use of 2,4-D for the control of stinkweed in oats. Carder, A. C. Three formulation, viz., the monohydrate sodium salt, the triethanolamine salt and the butyl ester of 2,4-D were applied at 2, 4, 8, 12, and 16 ounces acid equivalent per acre of stinkweed (Thalaspi arvense) in Victory oats. Two applications were made: The first when the stinkweed was in the 4-7 leaf stage or 1-2 inches high and the oats 4-5 inches high or in the early tillering stage; the second when the seed was starting to reach or 3-5 inches high and the oats

6-8 inches or in the tillering stage. From the standpoint of both weed control and the effect of the chemical on the oats results slightly favored the early application. Yield of the oats showed a slight promotion with all rates of the sodium salt, by this 2, 4, and 8 ounce rates of the amine, and by the 2-ounce rate of the ester. There was a sharp drop in yield when 16 ounces of the amine and 4 or more ounces of the ester were applied. Injury to the oats by these rates consisted of blasted panicles and miniature kernels. Maturity of the kernel was not unduly delayed by any treatment though ripening of the straw was seriously retarded by the above rates. A high degree of weed control was effected by 12 and 16 ounces of the sodium salt, by 8, 12, and 16 ounces of the amine and by 2 or more of the ester. Considering both weed control and injury to the oats by 2,4-D, 8 to 12 ounces of the sodium salt, 4 to 8 ounces of the amine, and 2 ounces of the ester score most favorably. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

13 Effect of the various 2,4-Dichlorophenoxyacetic acid formulation sprayed at 3 different growth stages with 5 different rates on Eagle Oats. Leggett, H. W. Stages were 3 leaf, 5-6 leaf, and late shot blade. Formulations were sodium, triethanolamine and butyl ester salts of 2,4-Dichlorophenoxyacetic acid at rates of 1/8, 1/4, 1/2, 3/4 and 1 pound acid per acre. Oats appears to be the least resistant of the cereal crops to 2,4-Dichlorophenoxyacetic acid. There is a general trend in decreasing yields between the 3 formulations with the butyl ester formulation decreasing yields the most followed by the triethanolamine and then by the sodium salt formulation. There is also a general trend of decreased yields towards later stages of spraying. The most significant results are from rates. Oats will not stand as high rates of acid per acre as will wheat and barley, 3/4 of a pound of acid of the sodium salt formulation being as high a rate as should be applied and 1/4 of a pound of acid of the triethanolamine and butyl ester formulations in the last two growth stages. (Contribution of Dominion Experimental Farms, Field Husbandry Division LaCombe, Alberta, Canada)

14 The effect of 2,4-D on oats when applied at 3 different growth stages at Ste-Anne De La Bocatiere. Godbout, Eugene. This experiment was conducted to determine the effect on oats when treated at three different growth stages, with the three formulations of 2,4-D at five rates of application. Erban oats was used for this purpose. The plots were one square rod and replicated three times. It does not seem to appear any difference between oats treated at different growth stages. With the three stages, the 3/4 and 1 pound of 2,4-D acid per acre of amine and ester types have had a bad effect on head formation while sodium salt at these rates has no injurious effect. The maturity was delayed only with 3/4 and 1 pound acid per acre of amine and ester type. With all treatments straw was not affected. There is no significance between the average yields of each growth stage. They are 55.3 for the three leafs, 56.5 for the five leafs and 55.4 bushels for the shot blade stages. It would seem that ester type affects oats more than the other types. For sodium salt type is the less injurious. The average yields are 55.6 for amine type, 53.5 for ester type and 58.1 bushels for sodium salt type. It may be surprising to report that the check has not yielded much more than the treated parts. The reason is that the land was not reasonably clean and consequently weeds have affected the yield of the check. (Contributed by Dominion Experimental Farms at Ste Anne De La Pocatiere, Quebec, Canada)

15 The effect of 2,4-D on oats varieties when applied at 5 rates to 3-leaf stage at Ste-Anne De La Pocatiere. Godbout, Eugene. This experiment was carried on to determine the effect of different types of 2,4-D applied at five rates on two varieties of oats (Ajax and Erban) in the 3 leaf stage. Due to limited space, the sodium salt type was not used but the amine and ester types of 2,4-D were applied at five rates on two varieties. The plots were one square rod and replicated three times. Thirty days after treatment, both types of 2,4-D at the 3 first rates of 1/8, 1/4, and 1/2 pound of 2,4-D acid per acre had not affected much of these two oats varieties. However, it was not the same for the rates 3/4 and 1 pound because these two last rates had materially affected the stand. Ajax oats seemed to be more sensible to 2,4-D than Erban. Ajax oats had yielded as a whole 11.8 to 13.8% less than the check, while Erban yielded 9.4 to 106% less than the check. Here too, Ajax seems to be more sensitive to 2,4-D. In general the 3/4 and 1 pound rates have reduced the yield from 13.5 to 19%. In these cases, heads were very much deformed and maturity was delayed of 3 days. The straw seems not have been affected by 2,4-D. No lodging and no root injury occurred. (Contributed by Dominion Experimental Farm Sta Anne De La Pocatiere, Quebec, Canada)

16 Effects of 2,4-D ester on malting barley. Corns, W. G. Olli malting barley grown on weed-free land at Edmonton was treated with an isopropyl ester formulation of 2,4-D applied as spray to triplicate sq.rd. plots at different stages of growth. Stage 1: June 7, 1948, barley 4" tall, 2 leaves, 5 days after emergence; rates 0,3,6,9 oz. 2,4-D equiv. in 20 gal. water/ acre. Stage 2: two weeks after emergence, plants 8", second tiller appearing; rates 0,3,6,9,12,16,20 oz. 2,4-D/acre. Same rates used at Stage 4: July 5, bases of spikes emerged. Only the 2,4-D rates greater than 9 oz. per acre caused delay in maturity (2-5 days) and in no case were any deformed organs produced. Despite some discrepancies, yields in general decreased as amount of chemical increased, and greatest reductions followed treatment at Stages 3 and 4. Tmts. with 3-6 oz. 2,4-D caused loss of 2-4 bu./acre. Ttmt. at Stages 2 and 3 with 9-20 oz. chem. reduced yields by 5-10 bu./acre and resulted in reduction of up to 14 bu./acre after Stage 4 tmts. Where yield was reduced by more than 5 bu. per acre, protein content was slightly increased (0,2-0.6%). Protein content of grain from plots treated with 3-6 oz. 2,4-D was apparently unaffected. (Contributed Dept. of Plant Science, U. of Alberta, Edmonton)

17 The effect of various 2,4-dichlorophenoxyacetic acid formulations sprayed at 3 different growth stages with 5 different rates of Olli barley. Leggett, H. W. Stages were 3 leaf, 5-6 leaf, and late shot blade. Formulations were sodium, triethanolamine, and butyl ester salts of 2,4-dichlorophenoxyacetic acid at rates of 1/8, 1/4, 1/2, 3/4 and 1 pound acid per acre. Barley appears to be the most resistant of the cereals to 2,4-dichlorophenoxyacetic acid. No significant differences in yields were found between rates, formulations or stages. There is, however, a marked general trend in yield decreases with later stages of growth and also a trend for yields to decrease as the rate per acre of 2,4-dichlorophenoxyacetic acid increases. Deformed type heads not nearly as marked as in wheat, larger percentage found in plots sprayed at 3 leaf stage. (Contribution of Dominion Experimental Farms, Field Husbandry Division, LaCombe, Alberta, Canada.)

18 The effect of 2,4-dichloropheroxyacetic acid as a selective herbicide on barley. Four row plots, with 9 inch spacing between rows, were treated with ester, amine salt and sodium salt at 1/4, 1/2, 3/4 and 1 lb. acid per acre, when the crop was 8 inches high. Vantage and Montcalm were weed free.

Yields and straw strength were statistically analysed. Yield. There was no significant difference between varieties and when influence of rates on yields alone was considered there was no sig. difference, nor was there any significance when rates times varieties were checked. There was, however, a sig. difference among formulations, ranking, (1) Amine, (2) check, (3) ester, (4) sodium, The interaction on yield of formultaions times rates was significant. Sodium to a greater degree than amine and ester depressed the yield at rates of ½ to 1 lb. Straw strength. Vantage had significantly the stronger straw. The difference among rates was highly significant with straw strength difinitely declining as rates increased. There was also a highly significant difference among formulations with sodium showing the greatest depressing influence on straw strength. Sodium exerted a greater depressing influence on straw strength at higher rates than ester and amine. Amine showed the least depressing effedt, ester slightly below amine but significantly better than sodium. Montcalm was weakened in straw by sodium more than was Vantage. Ester gave a parallel reaction but amine gave no sig. difference between varieties. (Contributed by the Field Husbandry Division, Dominion Experimental Farms, Brandon, Manitobe, Canada)

19 The effect of 2,4-D formulations on barley yields when applied to one variety in 1946 at three stages of growth and to eight varieties in 1947 and seven varieties in 1948 at four stages of growth at Scotland, South Dakota. Dersheid, Lyle A., L. M. Stahler and D. E. Kratochvil. Duplicate square rod plots of Wisconsin #38 barley were treated with the butyl ester and the triethanolamine, ammonium and anhydrous sodium salts of 2,4-D at the rates of 1.3 pounds of 2,4-D acid per acre when the crop was heading, fully headed and in the dough stage in 1946. Triplicate 4 x 12-foot plots of Plains, Feebar, Odessa, Spartan, Wisconsin #38 and Kindred were treated in 1947 and 1948. Tregal was also included in 1947 - with the butyl ester and the triethanolamine and monohydrate sodium salts of 2,4-D at the rate of 1 pound of 2,4-D acid per acre at the seedling, fully tillered, heading and fully headed stages of growth. Yield data were analyzed statistically each year. Significant changes in yields due to treatment at various stages were obtained in 1947 and 1948 with the fully tillered stage being high in 1947 and the seedling stage being low in 1948. Yields were significantly reduced each of the three years by applying the ester at these rates. The analysis of variance indicates a varietal reaction to treatments in 1948, and an L. S. D. indicates that untreated yields of Plains, Feebar, and Odessa were significantly higher than yields from any treated plot; whereas, the ester was the only treatment that reduced yields of Kindred, Wisconsin #38 and Manchuria. Yields of Spartan were not affected by treatment. A significant "F" value for "varieties x stages" was obtained in 1947 and 1948. The 1947 yields of Feebar, Odessa, Wisconsin #38 and Manchuria were significantly higher when treated at the fully tillered stage than at certain other stages. Wisconsin #38 and Manchuria repeated the 1947 performance in 1948. Plains, Odessa, Wisconsin #38 and Manchuria produced significantly lower yields when treated at the seedling stage than when treated at certain other stages, while Feebar was low when treated at the heading stage. This study indicates that 1 pounds of ester will reduce yields of all varieties and that 1 pound of either salt may reduce yields of Plains. Feebar and Odessa. It also indicates that barley in most susceptible in the seedling stage of growth and most tolerant at the fully tillered stage. (Contributed by the Agr. Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering USDA)

20 - Effect of 2,4-D as a Herbicide on Spring Barley, Bohmont, Dale W. Lico and Club Mariout, two varieties of spring barley, were planted in randomized, four-row plots, 10-foot long and replicated three times, sprayed at late boot and headed stage. The butyl Ester, Alkynol Amine and Sodium Salt of 2,4-D was applied at 1/2 pound and one pound of parent acid per acre. All material was applied at the rate of 20 gallons per acre. The yield of both barley varieties was reduced by treatment, the greatest reduction occuring when treated during the boot stage. There appeared to be no great difference in yield due to the formulations used. The Club Mariout variety of barley had a greater reduction in yield due to treatment than Lico barley, however, the difference was insignificant. (Contributed by the University of Wyoming)

21 Effect of various 2,4-dichlorophenoxyacetic acid formulations sprayed at 3 different growth stages with 5 different rates, on Thatcher wheat. Leggett, H. W. Stages were 3 leaf, 5-6 leaf, and late shot blade. Formulations were sodium, triethanolamine and butyl ester salts of 2,4-Dichlorophenoxyacetic acid at rates of 1/8, 1/4, 1/2, 3/4 and 1 pound acid per acre. Deformed type heads were only present in the 3-leaf stage sprayings and these increased in percentage as the rate of acid per acre increased and also as to formulation in the following ascending order, sodium, triethanolamine, butyl ester. There was no significant yield differences between formulations. Yield decreases were significant for stages of growth, the yield decreasing with later stages sprayed. Yields tended to decrease slightly up to the 3/4 pound acid application and at the 1 pound rate decreased significantly. Wheat appears to be intermediate in resistance to 2,4-dichlorophenoxyacetic acid. (Contribution of Domion Experimental Farms, Field Husbandry Division, LaCombe, Alberta, Canada)

22 Reaction of Mida wheat sprayed in root stage with three formulations of 2,4-D. Helgeson, E. A. Weed free Mida wheat was sprayed with aqueous solutions of sodium salt, alkanolamine and butyl ester formulations of 2,4-D in the boot stage at rates of 0.5 lb. and 1 lb. acid per acre. There was no marked effect on test weight or kernel weight from above treatments. Yields were reduced by 40% by all 1 lb. treatments and an average of 32% by all 0.5 lb. treatments. Treated plots averaged 2 days later in ripening than checks and there was marked lodging. (Contributed from North Dakota Agricultural Experiment Station.)

23 Reaction of some spring wheat sprayed with three formulations of 2,4-D at tillering. Helgeson, E. A. The bread wheats, Thatcher, Mida, Regent, Rival and Pilot and the durum wheats, Mindum and Carleton, were sprayed with aqueous solutions of sodium salt, alkanolamine, and butyl ester formulations of 2,4-D at 1 lb. acid equivalent per acre when fully tillered. Plots were cultivated to control weeds. There was no marked effect of any formulation on yield, test weight or kernel weight of grain. Treated plants tended to be about 2 days later than checks in ripening and slightly shorter in length of straw, with ester showing slightly more stunting than other treatments. (Contribution from North Dakota Agricultural Experiment Station)

24 Effect of 2,4-D as an herbicide on spring wheat. Bohmont, Dale W. Thatcher and Mida wheat were planted in randomized, four-row plots, 10 feet long and replicated three times. Treatments were made when the wheat was in the tillering, boot, and headed stages of growth. The butyl ester, alkynol amine and sodium salts of 2,4-D were applied at the rate of 1/2 and 1 pound of parent acid per acre. All material was applied at the rate of 20 gallons per acre. The two varieties differed in their reaction to treatments, the yield of Thatcher was reduced 2.2 bushels compared to the check while the average yield of Mida was reduced by 3,9 bushels. The yield of all treatments was reduced compared to the check with the exception of the 1/2 pound treatment at headed stage. At each stage of growth the one pound concentration caused a greater reduction in yield than the 1/2 pound treatment of the same formulations. Significant differences were found in materials, varieties and material x concentrations. The interaction of materials x stage of growth was highly significant. The late tillering of Thatcher had the largest yield loss compared to the early boot treatment of Mida. (Contributed by the Unif. of Wyo.)

25 Effect of 2,4-D as a selective herbicide on spring planted wheat, and barley. Foster, J. Roe. During 1948, sodium and triethanolamine salts and ester formulations of 2,4-Dichlorophenoxyacetic acid were applied to spring planted Thatcher wheat as a liquid spray and as a dust. Applications were made at 2,4, and 8 ounces of basic acid per acre. Treatment was made on one set of plots in the three leaf stage growth on June 21st. Spray applications at this stage of growth gave 50 to 100 per cent off-type heads of one kind or another. Dust applications gave 0 to 86 per cent off-type heads. Increased yields were secured in all cases where the spray or dust was used at this stage. The increase with spray was from 4.9 to 7.0 bushels per acre and from .4 to 5.1 bushels per acre with dust. On another set of plots, treatment was made at the 5 leaf stage on July 5th. At this stage, no off-type heads could be found at any rate of application used or with any formulation of either spray or dust. No significant increases in yield were obtained at this stage. In some cases the yield was depressed even when all weed competition was removed. The weeds encountered were Wild Mustard (Brassica, arvensis) and Stinkweed (Thlapsi arvense). All plots were 1/20th of an acre and were in triplicate, (Contributed of Dominion Department of Agriculture, Wxperimental Farms Service, Dominion Experimental Sub-Station, Regina, Saskatchewan, Canada.)

26 Controlling Annual Weeds in Wheat and Flax with 2,4-D and Allied Chemicals. Wood, H. E. and J. J. Bourns. Excellent control of several annual weeds was obtained under field conditions with tenth acre sprayed plots replicated at two locations, using lower than recommended rates of 2,4-D; the minimum of effect was noticeable on the crops and that only at higher rates, with none where sodium salt was used. Sodium salt was applied at 2,4 and 8 ounces acid per acre; amine and 2,4,5-T at 1½, 3 and 6 ounces; ester 1,2, and 4 ounces also two numbered products supplied by C.I.L. At Oak Bank, wheat was 5 - 6 inches high when sprayed May 28th, the weeds--wild mustard, stinkweed, crowfoot were quite small (except wintered-over stinkweed) another series in the same field was treated June 9th, with the weeds advancing in growth but not budding; at Sanford, one series only was sprayed June 19th, the wheat 7 - 10 inches high. Almost 100% weed control was obtained throughout, even at the lower dosages, except on the second date at Oak Bank with sodium salt at the low dosages, and on some in the winter annaul stinkweed. Some head malformation of wheat was noticeable, other than with sodium salt, with the upper dosage of all products used except June 9th (when wheat was past the susceptible stage). Flax was

treated from emergence to 4 inches in height. Similar weed control was obtained as with wheat. While the heavier dosages lodged the flax it soon recovered and, except for the 2,4,5-T at the two upper levels, showed no adverse affect from spraying other than being rather later in ripening later in ripening. A little wild buckwheat throughtout the plots, while not eradicated, was considerably checked in development. (Contribution of the Weeds Commission, Manitobe Dep rtment of Agriculture, Winnipeg, Canada).

27 Effect of various systemic (horome) herbicides on weeds and spring wheat in the early tillering stage. Pavlychenko, Thomas K. Duplicated, randomized and spaced 3 x 12 ft. plots of spring wheat on the sandy loam soil were treated, 21 days after emergence and at the late boot stage, with 2,3 and 8 ounces of acid eq. per acre of; Weedone concentrate 48 and Weedone #5 (ethyl esters, 2,4-D), LFN549 (ester 2,4,5-T), Weedar 64 (amine, 2,4-D), LFN472(2,4-D acid), 95% monohydrate sodium salt of 2,4-D and Weed-No-More (butyl ester, 2,4-D). Alternating controls were provided for each treatment. Russian thistle (Salsola kali) was the most important weed present. Results; at the early tillering stage esters and the amine salt gave 100 pct. kill of mustard (Sinapis arvensis) and Stinkweed (Thlaspi arvense) at all rates; LFN472 and Sodium salt at 2 and 4 oz/a rates were less effective (76 to 88% kill). Russian thistle was partially killed only by the higher rates of esters and amine salt (10 to 45%) but was strongly stunted and appreciably prevented from maturing seed by the lower rates of these chemicals and by LFN 472, and Sodium salt. Wild buckwheat (Polygonum convolvulus) was strongly resistant even the 8 oz/a rates of esters although it was noticeably stunted and the seed production reduced in all treatments. At the late boot stage the weeds were more advanced and resistant to all the chemicals used. Due to this fact and to the greater damage done by weeds prior to treatments the yield at this stage was very substantially reduced in both the controls and the treated plots. At both stages the treated plots usually yielded significantly more than controls. The ester plots produced higher yields at the medium and lower rates, while LFN472, amine and sodium salts have yielded more at the higher rates. (Contribution of Agr. Field Res. American Chemical Paint Co. Ambler, Pa)

28 Effect of various systemic (hormone) herbicides on spring wheat and common weeds. Pavlychenko, Thomas K. Plots 7260 sq. ft. in size, were treated in duplicate with alternating controls in the late boot stage at 2 and 4 ounces acid equivalent per acre of Weedone concentrate 48 and Weedone #5 (ethyl esters, 2,4-D), LFN549 (ester 2,4,5-T), Weedar 64 (amine, 2,4-D),LFN472 (2,4-D acid), 95% monohydrate sodium salt of 2,4-D, Weed-No-More (butyl ester 2,4-D) and Weedone concentrate 48 refined of free acid. The treatments were made at a critical time when the crop was seriously retarded due to very low moisture. Results: Wild mustard (Sinapis arvensis) was eliminated and stinkweed (Thlaspi arvense) was reduced to insignificant numbers by all the chemicals. Russian Thistle (Salsola kali) was permanently arrested in development and mostly prevented from seeding, although not killed, by the amine salt and all esters. The LFN 472 and sodium salt only partially stunted its growth and reduced the seed production by 70 to 80 per cent. Wild buckwheat was very resistant to all chemicals with only esters being somewhat more effective at the higher rates. Lamb's quater (Chenopodium album) was destroyed by 4 and seriously damaged by 2 oz/a rates. Redroot pigweed was only stunted but produces abundance of seed even at the higher rates. The reduction in weed growth soon was reflected in the color of grain, size of head, and finally in yield. All treatments yielded consistantly more grain (2.2 to 6.8 bu/a) and of higher grade. The higher rates

produced some stunting and gave none or smaller increases. (Contribution of Agric. Field Res., Amer. Chem. Paint Co., Ambler, Pa.)

29 Effect of 2,4-D as a selective herbicide on spring planted wheat, oats and barley. Friesen, H. A. Three formulations of 2,4-D at five rates, viz. 2, 2,6,12 and 16 ounces acid per acre were sprayed on Rescue wheat, Ajax oats and Titan barley. The sprayings were made at three different stages of growth, viz. 1) the three leaf stage, 2) the five leaf stage and 3) the shot blade stage. The tests were on weed free land. Abnormalities of the head, leaf, culm or root were not observed in either oats or barley as the results of any of the above named treatments. Yield differneces, significant at the five or one percent levels, were not recorded for barley or oats. Wheat treated during the three leaf stage with the ester at rates of 8, 12, and 16 ounces per acre resulted in 65, 80 and 95 percent, respectively, of deformed plants. The deformities were chiefly club-shaped heads, branched rachis, irregular spikelet arrangement, fused or missing glumes and thickened culm. Where the lower rates of the ester and the four higher rates of the amine and sodium salt were used, fewer deformities were observed, i.e. not more than 25 per cent of the treated plants. Yield differences between the treated and the untreated plots were not significant. Neither abnormal plants nor significant yield differneces were observed for wheat plots treated at either the five leaf or the shot blade stages. (Contributed by the Dominion Experimental Station, Scott, Sask.)

30 Effect of 2,4-D as a selective herbicide on growing crops of spring planted wheat, oats and barley. Ficht, J. 2,4-D treatments were applied in 1948 to growing crops of Stewart durum and Rescue wheat, Ajax oats and Titan barley. Applications were at rates of 2 and 4 ounces acid equivalent per acre of butyl ester, 3 and 6 ounces of triethanolamine, and 4 and 8 ounces of sodium salt. The crops were all grown on land summerfallowed in 1947. Russian thistle developed in 1948 to give what appeared like serious competition to all crops. Treatments made when the grain was tillering freely resulted in good weed control (except in the case of sodium salt), but did not show any consistant increases in yield over untreated check plots. While differences were not conclusive, the general trend of yields in treated plots as compared to untreated checks was as follows: oats, barley, and Rescue wheat unchanged; Stewart durum unchanged except in the sodium salt treatments where yields were depressed. This experiment agrees with 1947 results, which indicated that 2,4-D treatments would not be profitable for the control of Russian thistle in spring sown cereals on well farmed land. If weed competition is not considerable reduced by the treatment, there is a tendency for the yields of wheat and barley to be depressed by 2,4-D applications. (Contribution of Dominion Experimental Station, Swift Current, Sask., Dominion Experimental Farms Service, Canada)

31. Effect of 2,4-D as a selective herbicide in spring planted wheat, oats and barley. Davidson, J. G. During 1948 Thatcher and Redman wheat, Ajax and Exeter oats, and Montcalm and Vantage barley were sprayed at the three leaved stage with the sodium salt, amine and ester formulations of 2,4-D at the rates of 2,4,8,12 and 16 ounces acid per acre as project III-I of the NCWCC. Weeds were not a factor. The results were in wheat, maximum delayed maturity was 1.3 days. The straw was shortened and weakened at the heavier rates but less in Redman than Thatcher. The yield was stimulated in Thatcher at the 2 ounce rate throughout and with 4 ounces sodium salt and ester, while depressed at the 16 ounce rates. With Redman the yield was somewhat stimulated at all rates

of the sodium salt but was below the checks at all rates of the amine and ester. Off-type heads occurred in all treated plots with more in Thatcher than Redman. In the oats, maximum delayed maturity was 4 days. Straw was shortened and appreciably weakened at the heavier rates. Yield was depressed except at the 2 ounce amine rate. Off-types followed the same trend as in the wheat with Exeter showing the greater percentage in the amine and ester treatments. In the barley it was difficult to determine any 2,4-D effect by observation. Off-types in both varieties were negligible. Yields tended to be stimulated at 2,4, and 8 ounce rates and depressed at 16 ounces. Vantage did not show reduced yields with the amine treatments. (Contribution of Exp. Farms Service, Dept of Agr., Indian Head, Sask., Can.)

33 Effect of 2,4-D as a selective herbicide in wheat and barley. Sexsmith, J. J. The butyl ester of 2,4-D was applied at four rates (2,4,8 and 12 oz. per acre) and the triethanol amine was applied at three rates (4,8, and 12 oz. per acre) to six varieties of wheat (Saunders, Redman, Thatcher, Marquis, Rescue, Lemhi), and six varieties of barley (Glacier, Olli, Titan, Trebi, Compana, Montcalm). Due to adverse weather conditions, treatments were delayed, and when treated on July 1, the earliest variety of barley was 90% headed, and the earliest variety of wheat was beginning to head. From the yield data of all varieties of wheat (Table I) it was found that the ester at 12 oz. was the only treatment causing a significantly lower yield. For barley, the ester at 4,8 and 12 oz. and the amine at 12 oz. significantly lowered yields. There was considerable variation in yields, and no difference was noted in the reaction of different varieties of either wheat or barley. For the variety Marquis (Table II) the yields were significantly reduced by the ester at 8 and 12 oz. There was a general downward trend of yield with increased rate of amine, but the differences were not significant. Samples of twenty-five heads were collected from each of the barley plots, hand threshed, cleaned, and weighed (Table III), the results show that only the amine at 4 oz. did not adversely affect weight of grain produced. The differnece in weight of grain were apparently the result of the increase in number of sterile florets resulting from 2,4-D treatment. (Contr. of Dom. Dept. Agr. Exp. Sta., Lethbridge, Alta.)

32 The effect of 2,4-D on wheat, oats and barley. Olson, P. J. and Saul Zalik, Ester (butyl) at 16 oz. per acre (pure acid equivalent) applied when plants were 4 to 5 inches tall, reduced yields somewhat in each of Redman and Thatcher wheat, Stewart durum, Montcalm and Vantage barley, Ajax and Exeter oats. The reduction was statistically significant in the case of Redman wheat, Exeter oats and Vantage barley, severe yield reduction resulted. Ajax oats treated 5 to 6 days after heading and Exeter 3 days before heading showed some yield reduction at 4, 8 and 16 oz. ester, but this was of doubtful significance. No damage resulted for trienthanol amine or sodium salt. In a separate experiment, 12 oz. ester was applied to Montcalm barley at 20 dates at 3 day intervals beginning 3 days after seeding and continuing until 18 days after heading. Significant decreases in yield resulted from the third application, plants 1 in, tall, and from the fifth application, plants 2 in. tall, (a light frost the night following the fifth application froze the plants on this plot but not on any of the others.) The thirteenth, fourteenth and fifteenth application, made while the plants were advancing from 4 days before to 2 days after heading, alsoccaused significant yield reductions. (Contribution of the Division of Plant Science, The University of Manitoba, Winnipeg.)

PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS

Flax Investigation leader: R. S. Dunham

The abstracts submitted for review are summarized on the basis of objectives of the investigations rather than on authorship. Thus, the material reported in a single abstract may be divided in the following summary.

Formulations. Most investigators found the esters more liable to cause reduced yields and greater delay in maturity than the sodium or amine salts when equivalent amounts of acid were used. Bakke & Staniforth report good weed control with 0.66 & 1.3 oz. of the butyl ester & mention no reduction in yield. Carder reports some reduction in Redwing from 2 oz., & Davidson as much as 26% reduction in Royal from 2 oz. Dunham & Robinson report reduced yields of Koto from 1.3 & 2.6 oz. & reduced yields of Crystal from 0.33, 0.65, 1.3, & 2.6 oz. when the flax was kept weed-free. Mustard sown with Koto & Crystal was almost eliminated by 0.65 oz. & completely killed with 1.3 oz. but no increase in flax yield resulted. Pavlychenko killed flax 100% with 2 oz. of the ester of 2,4,5-T.

Carder got no reduction in yield of Redwing from 12 oz. of sodium & only a small decrease from 8 oz. of amine. Mustard was practically eliminated from Koto & Crystal by 2 oz. of sodium salt for Dunham & Robinson & yields of flax were increased as a result. Up to 8 oz. had no injurious effect on these varieties kept free from weeds.

Sodium salt failed to control Russian thistle at 4 & 8 oz. for Picht even when treated twice 2 weeks apart. Amine at 3 oz. & ester at 2 oz. were effective when applied twice at the same rate. Davidson successfully killed Canada thistle top-growth with 4 oz. of amine or ester but reduced the yields of Royal & Dakota seriously with 2 oz. of ester. Because of better weed control, Derscheid & Kratochvil got better yields from Dakota treated with 4 & 6 oz. of amine than with ammonium TCA at 6 pounds or the ammonium salt of dinitro-o-sec-butylphenol at 1 pound per acre.

"Oils, oils fortified with PCP or sodium PCP in water spray cannot as yet be recommended for control of weeds in flax" conclude Stahler & Derscheid. Marked reduction in flax yields or poor to fair control of weeds resulted from their trials.

In the only comparison of varieties reported, Dunham & Robinson found no varietal difference among 10 common seed-flax varieties in the response to 4 oz. of amine or 1.3 oz. of ester. The ester sprayed plots yielded less than amine treated plots & both the amine & ester yielded less than the check.

Straw yields are reported only by Taylor & Dunham-Robinson. The former worked with fiber flax & found only sodium at 4 & 8 oz. & amine at 4 oz. promising treatments. The latter found no reduction in straw yields of 10 seed-flax varieties from 4 oz. of amine or 1.3 oz. of ester & no effect on straw yields of Koto & Crystal from 8 oz. of sodium or 2.6 oz. of ester.

No information relative to the effect on oil percentage & iodine number was received. Neither were there any direct comparisons among different amines or esters.

Time of Treatment. Most investigations showed that reduced yield or other injury not only depended on formulations & rates but also on the stage of growth in

flax at the time of treatment. There were no reports of injury from spraying done too early. Corns applied the amine to Redwing in pre-emergence treatments on the day planted & 2 days before emergence without any effect on flax or mustard. Post emergence spraying at emergence and 1 week later had a negligible effect on weed-free flax and resulted in the best kill of mustard and maximum imporvement of flax yields where weeds were present. Amine at 6 oz. was used. The same treatment at 5" and pre-bud stage caused recognizable injury to weed-free flax and only small increases in weedy flax. Yields of Royal were not reduced when sprayed at the "six true leaf" stage by Friesen with 2, 4, 8, 12, & 16 oz. of "3 formulations of 2,4-D". Zalik & Olson report no damage to Royal and Dakota sprayed with 8 oz. of sodium, amine, or ester, at the 3-4" stage.

Pavlychenko found the sodium salt safe from 2-21 days after emergence and the amine and ester applied not earlier than 12 days. Carder had no reduction in yield from sodium up to 12 oz. at the 4-5" stage but smaller amounts were harmful in early bud and late bud. Four ounces of amine were not harmful at the 4-5" stage but reduced yields at the late bud stage. Even 2 oz. of ester affected yields adversely at all three stages.

Taylor found no differential effects on fiber flax when sprayed at either 4" or 8" with sodium, amine, and ester.

Derscheid and Kratochvil, Pavlychenko, and Zalik-Olson agree that spraying at blossom time resulted in poor weed control and reduced flax yields.

Maturity. Delay in maturity as a result of spraying flax with 2,4-D was commonly mentioned. The maximum delay amounted to 22-27 days as reported by Pavlychenko using 2-4 oz. of ester at late bloom, by Carder using 8-12 oz. of ester at 4-5" stage and later, and by Corns using 4-8 oz. of amine at flowering.

Delays of less than three days resulted from 2,4-D and the sodium salt at 4 oz. applied 2, 6, 9, 12, and 21 days after emergence in Pavlychenko's trials. Only at 12 days after emergence was the delay less than 3 days with 4 oz. of amine. Two oz. of ester resulted in more than three days delay at all stages in these trials. The delay in Carder's trials was less than three days with 4 oz. of sodium at 4-5" and 6-7" stages. Four ounces of amine and 2 ounces of ester caused more delay at the three stages tried. Taylor found that 4 oz. of sodium, amine, or ester delayed maturity of fiber flax five days when sprayed at 4" and 8". Davidson sprayed Royal and Dakota at 5". The sodium salt did not appreciably affect maturity up to 16 oz. nor did the amine or ester up to 12 oz.

Miscellaneous. Sachston reports observations that indicate the severity of rust of Redwing may have been influenced by 2,4-D treatment because of delayed maturity. No change in the rust reaction of the flax was observed but the amount of infection seemed associated with the longer period for development of rust. Dunham and Robinson found no differences in seed or straw yields of flax grown from seed of Koto sprayed in 1947 with 3 formulations of 2,4-D at three rates, and at four stages of growth. There is still a possibility, however, that the affect of treatment could show up in a crop next year.

Discussion. From the abstracts and data submitted, it is apparent that injury to flax is more liable from overdoses of ester than the amine and least liable from the sodium salt. The correct dose will vary with varieties which differ

in tolerance and with the stage of flax development at time of treatment. While the injury to the crop may be more than compensated by removing the competition of weeds, it is not always so. Apparently ester should be applied in early stages of flax growth, to varieties known to be tolerant, and at rates of 0.65 to 1 oz. per acre. Straw yields are much less affected than seed yields among the seed flaxes.

Delay in maturity from 2,4-D treatment is reported by most investigators. Data by Tandon and Dunham not included here show that delay at blossom is greatly reduced by harvest if practical dosages applied at the proper time are used. Two possible explanations for these contradictory results cannot be tested because of insufficient pertinent information in the reports submitted. (1) Delay as reported may have been measured at bloom, rather than at maturity. (2) Flax ripening too late in the season may prolong the process abnormally and any delaying effect of treatment might be exaggerated.

PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS.

Abstracts of Results of Individual Cooperators.

Flax

34 The control of weeds in flax by the use of chemicals. Bakke, A. L. and David W. Staniforth. Last year it was reported from the Iowa Agricultural Experiment Station that broad leaved annuals in flax could be controlled without a significant reduction in yield by spraying flax with 2,4-D formulations when the flax was 6-10 inches in height. Flax sprayed with Weed-No-More (Butyl ester) at a concentration of 1/8 pint (1/24 pound) yielded 22.86 bushels per acre, 1/4 pint 18.45 bushels while the control produced 17.15 bushels. In 1948 the experiments were repeated. The yields were much the same as in the preceeding year. In concentrations over 1/24 pound per acre of the butyl ester there was a temporary retardation in growth; this retardation was increased with the more concentrated sprays but when the seed was harvested there was no difference in height. Good control of weeds in flax was obtained by using the butyl ester 1/24 pound, 1/16 pound, and 1/4 pound per acre. The sodium salt, amine salt, Dow Selective, Sinox, Sinox W, and Santobrite (PCP, sodium salt) also gave good weed control in flax. It appeared as if the 5 gallons per acre application did not give as good distribution as the more dilute solutions. (Contribution of Iowa Agricultural Experiment Station, Botany and Plant Pathology Section, Ames, Iowa.)

35 The effect of 2,4-D on flax. Carder, A. C. (Three formulations, viz.) The monohydrate sodium salt, the triethanolamine salt, and the butyl ester of 2,4-D were applied at 2, 4, 8, and 12 ounces acid equivalent per acre to Redwing flax at 4-5 inches high, 6-7 inches or early bud, and 15-20 inches or late bud stage. The flax was infested with a light growth of lamb's quarter (Chenopodium album) and ball mustard (Neslia paniculata). Application of 2,4-D when the flax was 4-5 inches tall brought about the least depression of yield and the least delay in maturity of the flax, while at the same time effecting as good a control of weeds as the later treatments. The sodium salt even at 12 ounces caused no reduction in yield, while the amine at 8 ounces depressed yields slightly and at 12 ounces perceptibly. The ester at 2 ounces reduced yields slightly and at 4 or more ounces considerably. The maturity period of the flax was delayed a week or more by the 8- and 12-ounce rates of the amine and by the 4-, 8-, and 12-ounce rates of the ester. Effective control of lamb's quarters and ball mustard was obtained by 12 ounces of the sodium salt; 4, 8, 12 ounces of the amine; and by 2 or more ounces of the ester. The experiment points to a fine balance between effective weed control and positive injury to the flax. The results indicate that this point was most closely approached with 12 ounces of sodium salt or 4 to 8 ounces of the amine. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

36 Effect of 2,4-D on flax and commercial mustard. Corns, W. G. Pre-emergence sprays with 0, 4, 8, 12, 16 oz. 2,4-D equiv. (Triethanolamine) and post-emergence treatments with 0, 2, 4, 6, 8 oz. 2,4-D per acre were each replicated in quadruplicate sq. rd. plots at Edmonton in factorial experiments with Redwing flax (a) Weed-free (b) "Weedy": sown with yellow-seeded Brassica nigra. Treatments on day of planting and 2 days before emergence of plants had

no appreciable effect on stand of flax or mustard. Post-emergence treatments at time of nearly complete emergence and one weed later (Stage 4) caused temporary retardation in development, and negligible effects on yield of weed-free flax. In weedy plots such treatments gave best kill of mustard and maximum improvement in flax yields (6 oz. 2,4-D increased yield by 12 bu. acre). Treatments at Stage 5 (flax 5", 3 weeks after emergence), Stage 6 (1 mo. a.e. mustard in bloom), and at Stage 7 (flax in bud) caused recognizable injury to flax. The 8 oz. treatments reduced yield of weed-free flax by more than 2 bu. per acre. On weedy ground treated at these stages, marked reduction in yield of mustard seed was achieved by 6-8 oz. 2,4-D but maximum improvement in flax yield was only 1/5 that noted for Stage 4 treatments. In addition, there was more than a week's delay in maturity of flax treated at bud stage with 4-8 oz. 2,4-D. Treatments at flowering stage caused injury resulting in more than 3 week's delay in maturity of flax and had negligible effect on yield of then podded mustard. (Contribution of Dept. Plant Sci. University of Alberta, Edmonton.)

37 Effect of 2,4-D as a selective herbicide in linseed flax. Davidson, J. G. During 1948 Royal and Dakota flax, when averaging 5 inches high, were sprayed with the sodium salt, amine, and ester formulations of 2,4-D at the rates of 2, 4, 8, 12, and 16 ounces acid per acre as project III-I of the NCWCC. The sodium salt did not appreciably affect maturity nor did the lower rates of the amine or ester. At the 16-ounce rate, the amine and ester delayed maturity around 5 days. Sodium salts had the least affect on yield. Reduction in yield in the 16-ounce treatment was 4% in Royal and 13% in Dakota. The amine reduced Royal 58% and Dakota 35%, and the ester 43% and 46%, respectively. Treated at 2 ounces the amine reduced yields nearly 2% in Royal and increased it almost 10% in Dakota while the ester reduced yields about 26% and 20%, respectively. In the early stages treatment injured Royal flax more than Dakota. The heavy applications of the amine and ester caused much twisting and bending of the plants in both varieties. Weeds were present in all plots before treatment. These were stinkweed, redroot pigweed, lamb's quarters, purslane, wild mustard, and some early season Canada Thistle, the top growth of which was gradually killed by 2 ounces of each formulation. The ester was more effective than the amine at 2 ounces but both gave reasonable weed kills at 4 ounces. The sodium salt was somewhat less effective at these rates. Greatest yield reduction due to weeds was less than 11%. (Contribution of Exp. Farms Service, Dept. of Agr., Indian Head, Sask., Can.)

38 Effects of TCA, 2,4-D and selective dinitro on the yields of flax when applied to three different growth stages. Derscheid, Lyle A. and D. E. Kratochvil. Square rod plots of Dakota flax that was lightly infested with lamb's quarters (Chenopodium album), rough pigweed (Amaranthus retroflexus), common ragweed (Ambrosia artemisifolia), Kochia (Kochia scoparia), foxtails (Setaria viridis and glauca B.) and some barnyardgrass (Echinochloa Crusgali) were treated in triplicate with 4 and 6 pound applications of the ammonium salt of TCA, 1/4 and 3/8 pound applications of the triethanol amine of 2,4-D and 3/4 and 1 pound applications of the ammonium salt of dinitro-o-sec-butylphenol. Treatments were made when the flax was 3 to 6 inches tall, in early bud, and in full bloom. The dinitro and TCA did not give any weed control but both rates of 2,4-D gave effective control of the broad-leaved weeds when applied at the two earlier stages. An analysis of variance indicates that yields from plots treated with 2,4-D were significantly higher than yields from untreated plots or from plots treated with any other chemical; and it also indicates that plots,

treated with 2,4-D at the two earlier stages of growth, produced a significantly higher yield than plots treated when in full bloom. The weed control probably accounts for these differences. Significant differences in yields due to treatment with TCA or dinitro at the various stages of growth was not established. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station.)

39 Effect of 2,4-D on flax with and without weeds. Dunham, R. S. and R. G. Robinson. Koto and Crystal were treated at the rate of 2, 4, 6, & 8 oz. of the sodium salt of 2,4-D and .33, .65, 1.3, & 2.6 oz. of the butyl ester of 2,4-D per acre in 20 gals. of water. Checks were sprayed with water. One set of plots for each variety was kept weed-free by cultivation. In a second set, lamb's quarters (Chenopodium album) & wild mustard (Brassica arvensis) were sown in the row with the flax but the space between rows was cultivated. Wild buckwheat (Polygonum convolvulus), rough pigweed (Amaranthus retroflexus), and pigeon grass (Setaria spp.) were also present. Plots consisted of 3 rod rows and were replicated 4 times. Treatments were randomized. The application of the sodium salt at all rates increased yields of both varieties over check when weeds were present. Without weeds, yields of the flax were not affected. The ester did not significantly affect yields of flax with weeds but without weeds it reduced yields of Koto at the two higher rates and Crystal at all rates. Mustard was almost eliminated by 2 oz. of sodium. Two-thirds of the stand or more was killed by .33 oz. of ester, it was almost eliminated by .65 oz., and completely killed by 1.3 oz. The sodium salt showed little effect on lamb's quarters but the heavier rates of ester reduced stand from 50 to 88%. Straw yields were not affected by chemical treatments. (Contribution of the Div. of Agron. & Pl. Gen., Uni. of Minn., St. Paul, Minn., in cooperation with the Sherwin-Williams Co. Paper No. 640 of the Misc. Jour. Series, Minnesota Agricultural Experiment Station.)

40 Response of flax varieties to 2,4-D. Dunham, R. S. and R. G. Robinson. Ten commonly grown flax varieties were sprayed when 5-7 inches tall at the rate of 4 oz. of triethanol amine and 1.3 oz. of the butyl ester of 2,4-D in 20 gals. of water per acre and compared with a water sprayed check. Varieties used were Crystal, Arrow, Minerva, Koto, Sheyenne, Royal, Victory, B5128, Dakota, and Redwing. A plot consisted of 3 rod rows of each variety replicated 6 times with varieties and treatments randomized. Plots were kept weed-free by cultivation. The seed yields were affected significantly by the treatments but not the straw yields. The applications of ester resulted in lower seed yields than on the amine treated plots and both the amine and ester reduced yields below the check. All varieties responded alike to applications of amine and ester at these low rates. (Contribution of the Div. of Agron. & Pl. Gen., Uni. of Minn., St. Paul, Minn., in cooperation with the Sherwin-Williams Co. Paper No. 641 of the Misc. Jour. Series, Minn. Agr. Exp. Sta.)

41 Growth and yields of 1st generation progeny from 2,4-D sprayed flax plants. Dunham, R. S. and R. G. Robinson. Seed from Koto flax plants sprayed in 1947 with water and the sodium, amine, and ester of 2,4-D at 4, 12, and 24 oz. per acre and at 2", pre-bud, late bud, and full bloom stages was sown in replicated and cultivated rod-row plots. Yields were based on 3 replications of rod-row plots and observations of individual plants were made on a fourth space-planted replication. The seed used from plants sprayed in 1947 all germinated 90% or better. No differences in seed or straw yields

were obtained in 1948. Plant heights, branching, and abnormality notes have not been summarized at this date. (Contribution of the Div. of Agron. & Pl. Gen., Uni. of Minn., St. Paul, Minn., in cooperation with the Sherwin-Williams Co. Paper No. 642 of the Misc. Jour. Series, Minn. Agr. Exp. Sta.)

42 Effect of 2,4-D as a selective herbicide in growing crops of flax. Ficht, J. Double treatment of flax was tried for the control of Russian thistle. Plots were treated when the flax was 1 inch high, and treatments were repeated two weeks later. Weed emergence was incomplete at the time of the first treatment. Russian thistle seedlings had not formed lateral branches. A fairly heavy infestation of weeds emerged after the first treatment, and were at the pre-branching stage when the second treatment was given. Applications were 2 and 4 ounces acid equivalent per acre of butyl ester; 3 and 6 ounces triethanolamine; and 4 and 8 ounces sodium salt. In plots receiving double treatment, the second application was at the same rate as the first.

The sodium salt failed to control Russian thistle. The amine and ester gave very good weed control at both rates in the double treated plots. The weed control was slightly poorer in plots treated only once on the second date. Weed infestation in plots treated on the first date only, appeared almost as heavy as in the untreated checks. Yields from untreated checks averaged 7.3 bushels per acre. Plots treated on the first date only, showed an increase of about 1 bushel per acre. Plots treated on the second date only, showed an increase of 2.3 bushels per acre, and tended to produce slightly more than plots given the double treatment. (Contribution of Dominion Experimental Station, Swift Current, Sask. Dominion Experimental Farms Service, Canada.)

43 Effect of 2,4-D as a selective herbicide on linseed flax. Friesen, H. A. Three formulations of 2,4-D at five rates viz: 2, 4, 8, 12, and 16 ounces acid per acre were sprayed on Royal flax. The sprayings were made at three different stages of growth; namely, 1) when the flax had six true leaves, 2) when flax was in the rapidly growing or pre-bud stage, and 3) when flax was in the flowering stage.

Flax treated during the first or early stage suffered severe stem curling from the butyl ester at dosages of 8, 12, and 16 ounces. Plots treated with the amine at 12 and 16 ounces showed a slight degree of stem curling. However, the flax recovered and grew normally within two weeks after treatment, but its maturity was delayed for as much as six days. Significant yield differences between the treated and untreated plots were not found to exist.

Treatments made during the pre-bud stage resulted in a high proportion of deformities, particularly where the ester at 8, 12, and 16 ounces and the amine at 16 ounces were used. The chief deformity noted was a halting of growth at the growing point with subsequent branching from this point. The main root was swollen and bore evidence of slight lesions. Significant yield differences were not found to exist between the treated and the untreated plots. (Contribution of the Dominion Experimental Station, Scott, Sask.)

44 Effect of various systemic(hormone) herbicides on flax from pre-bud to late bloom stage. Pavlychenko, Thomas K. The season at Saskatoon was dry and hot. Duplicate, 3x12 ft., spaced plots of Royal flax on the Sask. loam

soil were treated with: Weedone conc. 48 and Weedone #5(ethyl esters), LFN549 (ester, 2,4,5-T), Weed-No-More(butyl ester), Weedar 64(amine salt), LFN472 (2,4-D acid) and 95% Monohydrate sodium salt at 2, 6, and 8 oz. of acid eq./a. Four series were treated, 1 & 2, in pre-bud stage, with 6 & 8 oz/a respectively; 3 & 4, in late bloom, with 2 oz/a rates, but 2 oz/a of thiourea was added to each chemical in the 3rd and 4 oz/a in the 4th series. Results: the crop was 100% killed in the pre-bud series by LFN549 (series 1 & 2); 3 esters seriously injured the growing point of flax, caused 20-35% sterility and 2 weeks delay; Weedar, Sodium Salt and LFN472 were less injurious in this order, causing 12, 12, & 8 days delay, and 16, 12, & 10% sterility respectively. Plots of these chemicals gave the highest yield in both series. Yet these were significantly reduced by less effective weed kill. In the late bloom series (3 & 4) strong to severe twisting, discoloration, enonomically significant delay (up to 26 days) & high sterility (up to 42%) of bloom & young bolls was caused by all chemicals. Yields were uniformly low and advanced weeds were not adequately controlled, although Russian thistle was definitely stunted. All treatments in late bloom stage produced a lasting injury to the crop, lower yield & inadequate weed control. Wild mustard, stinkweed, lamb's quarters, and R. pigweed were killed 100% by 2 & 4 oz. of all chemicals except 2 oz. of sodium salt & LFN472 which gave 85% control. Surviving plants from flax injured by the chemicals especially the esters of 2,4-D & 2,4,5-T produced abundant branches frequently with good bolls. (Contribution of Agricultural Field Res. Amer. Chem. Paint Co., Ambler, Pa.)

45 Effect of various systemic(hormone) herbicides on flax from emergence to 21 day stage. Pavlychenko, Thomas K. 1948 was dry and hot. Duplicate, 3x12 ft., spaced, Royal & Redwing flax plots on the Sask. sandy loam soil were treated with: Weedone conc. 48 and Weedone #5(ethyl esters), Weed-No-More (butyl ester), LFN549(ester of 2,4,5-T), LFN472(2,4-D acid), Weedar 64(amine salt), 95% monohydrate sodium salt and Thiourea at rates of 2 & 4 ounces acid eq/a. Flax was treated 2, 6, 9, 12, and 21 days after emergence. Results: at the 2 day stage, 2,4,5-T killed the crop at both rates. The esters & the amine salt caused severe twisting, from 3-12" stunting at maturity, 4-15 days delay, & 20-96% kill. Sodium salt & LFN472 produced slight twisting but no stunting, delay or kill. The esters & amine salt gave very high control of susc. weeds but only stunted and did not kill thistle. At 6 & 9 day stages, 2 & 4 oz. rates, there was less twisting, stunting & killing of crop, yet treatments, except LFN472 & sodium salt, were very damaging. At 12 days, at both rates, considerable twisting, but less damage to the growing point resulted. Stunting at maturity was only 1-3 inches, delay 1-6 days & 2-10% kill. Heavier damages were caused exclusively by esters with other chemicals barely injurbous at this stage. At 21 days no kill was caused by any chemical excepting LFN549, 4 oz/a (30%), but twisting, stunting & delay again were significant in 4 oz. ester plots. It seems quite safe to treat flax with LFN 472 and sodium salt any time between the 2 & 21 day stages. The amine & esters should not be applied before the 12 day stage. Wild mustard, stinkweed, lamb's quarters, & R. pigweed were killed 100% by 2 & 4 oz. of all chemicals except 2 oz. of sodium salt & LFN472 which gave 85% control. Surviving plants from flax injured by the chemicals especially the esters of 2,4-D & 2,4,5-T produced abundant branches frequently with good bolls. (Contribution of Agric. Field Res., Amer. Chem. Paint Co., Ambler, Pa.)

46 Effect of 2,4-D on severity of flax rust. Sackston, W. E. As a result of greenhouse and field experiments and observations made in Manitoba from 1946 to 1948 it was concluded that spraying flax with 2,4-D did not affect the reaction of the crop to rust, pasmo, anthracnose, or browning. Observations made in 1948 at the Dominion Experimental Farm, Lacombe, Alberta, however, indicate that the severity of rust on Redwing flax may be influenced by 2,4-D treatment. 2,4-D sprays applied just before the flax bloomed delayed maturity of the crop as much as 10 to 14 days in some cases, according to H. W. Leggatt, who was in charge of the experiment. When the plots were examined by the writer on September 6, it was found that the naturally-occurring rust was heaviest on the flax plots that had been delayed in maturity the most as a result of 2,4-D treatment. There was more rust on the plots sprayed with an ester formulation than with a sodium salt or an amine; there was more rust on plots sprayed at the pre-bloom stage than at 3"-4" or 6"-8" high; and there was more rust on plots sprayed at the rates of 3/4 and 1 pound of acid per acre than on those sprayed with 1/8 to 1/4 pound. There was no apparent change in the rust reaction of the flax; the heavier infection seemed to be due entirely to the delayed maturity of the flax and consequent longer period for development of the rust. (Contribution of Dominion Laboratory of Plant Pathology, Winnipeg, Manitoba, Canada.)

47 Effect of herbicidal oils, oils fortified with PCP and sodium PCP in water spray on weeds in flax and yield and test weight of flax. Stahler, L. M., Lyle A. Derscheid. Triplicated randomized plots of Dakota flax, infested with Setaria spp., Panicum spp., Echinochloa spp., Polygonum spp., Amaranthus spp., and Ambrosia spp. were sprayed when flax was 4-6 inches and weeds in seedling stage with Shell Oil Co., ACX 184, ACX 170, ACX 224, various herbicidal oil fractions at 40 and 80 gallons per acre. Shell Oil ACX 238 and 237 containing .25% and 2.5% PCP respectively at 40 gallons water per acre and 4 & 8 pounds sodium PCP in 40 gallons water per acre were also used. Oil ACX 184 gave no reduction in yield or test weight of flax; no control on broad-leaved weeds 25 & 75% control of grass weeds at 40 & 80 gallons respectively. ACX 140 gave no reduction in broad-leaved weeds, excellent control of grassy weeds. Marked reduction in flax yields at both rates; ACX 224 gave equal control of weeds, only slight reductions in yield of flax at higher application rate. Oils fortified with PCP gave fair control of all weeds, reduced yields of flax 50% or more. Sodium PCP in water gave only fair control of broad-leaved weeds, poor control of grassy weeds, no depressions in yield of flax. This investigation indicates that oils, oils fortified with PCP or sodium PCP in water spray cannot as yet be recommended for control of weeds in flax. (Contribution of Bureau of Plant Industry, Soils and Agricultural Engineering of U.S.D.A. and Agronomy Department of South Dakota State College.)

48 Effect of 2,4-D as a selective herbicide in flax. Taylor, D. K. During 1948 low volume applications of three formulations of 2,4-D were applied to one-half square rod plots of fibre flax. The four concentrations of the sodium, amine, and ester salts were 1/4, 1/2, 3/4, and 1 pound per acre applied at two stages of growth, 4 & 8 inches. In order to study the tolerance of the flax to these chemicals the plots were grown in a weed-free area. While no real differences were found between the two stages of application, significantly lower yields of straw and seed were obtained from the higher concentrations of all salts. Under the weed-free conditions of this experiment only three treatments were promising; namely, the sodium salt at 1/4 & 1/2 pound per acre and the amine salt at 1/4 pound per acre. In comparison to the

untreated plots delays in maturity up to two weeks were experienced while in the average height of the treated plots was reduced as much as 15 inches for the ester salt at the 1 pound rate. (Contribution of Dom. Exp. Farm, Agassiz, B. C.)

49 Effect of 2,4-D on flax. Zalik, Saul and P. J. Olson. An amine (triethanol), and ester (butyl), and a sodium salt of 2,4-D were applied at rates of 2,4 and 8 ounces pure acid per acre to Dakota and Royal flax. When applied at the 3 to 4 inch growth stage, none of the treatments caused any damage. The 4 and 8 oz. rates of amine and ester applied at the blossom stage resulted in 3 to 10 days delay in maturity, infertility of flowers, and consequent reductions in yield. These yield reductions were significant for the 8 oz. rates. (Contribution of Division of Plant Science, The University of Manitoba, Winnipeg, Canada.)

PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS

Fall Planted Wheat, Oats, or Barley — Investigation Leader: W. C. Elder

It appears from the 1948 abstracts that growing conditions are major factors to consider in the use of 2,4-D as a selective herbicide on winter wheat. Most of the experiments were conducted in the hard red winter wheat belt where rainfall was variable. In Kansas and Oklahoma it was unusually dry and injury to wheat did not occur under rates of 3/4 lb. of ester or 1 lb. of salt or amine formulation per acre. Under favorable growing conditions in Nebraska slight injury occurred in 1/8, 1/4 and 1/2 lb. rates of ester per acre with heavy damage at 3/4 lb. or above. One pound of amine salt gave about the same injury as 1/2 lb. ester. 2,4,5-T ester and 2,4-D ester reduced yields of wheat the same when used at the 1 lb. level.

From a review of the 1948 abstract data it is evident that winter wheat is more resistant to 2,4-D in early spring when fully tillered or in early joint stage and more susceptible when treated soon after planting in the fall months. The boot to heading stage is a susceptible period. The 1948 uniform plan did not call for treatments from blooming time until harvest and the meager information received is insufficient to indicate any definite trend for the late applications.

The ester formulations consistently gave better control of weeds when compared with the other formulations at the same rate of application. The ester injured wheat at much lower levels than the amine and salt types of 2,4-D. One investigator reports results were about the same for several esters when applied from an airplane. 2,4-D mixed in one gallon of diesel fuel per acre gave as good coverage as 5 gallons of water. Two gallons of water was unsatisfactory for airplane spraying.

It is apparent from the reports that most common annual weeds found in wheat can be controlled with 2,4-D at rates much lower than those seriously injurious to the crop. 1/4 to 1/3 lb. per acre of ester and 1/2 to 3/4 lb. per acre of salt or amine controlled most annual weeds when young. As the weeds increased in size and age more 2,4-D was necessary for satisfactory control. Where heavy rates are required to kill noxious perennial weeds some injury to the wheat can be expected; however, many times the loss is no greater than it would be from the weeds if they were allowed to grow.

Where wheat was growing vigorously when treated and yields lowered, the kernels and spikelets per head were reduced, especially in the early boot stage. Other factors affected were maturity and weight per bushel, while germination, tillering and number of head were not affected. Under dry growing conditions, germination, protein and quality of wheat were not affected when one pound or less of 2,4-D was used per acre. No information was received on the response of different varieties of winter cereals to 2,4-D.

No abstracts were received on winter oats and only one on winter barley. It seems the response of barley to the use of 2,4-D is very similar as that of winter wheat.

PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS

Abstracts of Results of Individual Cooperators.

Fall Planted Wheat, Oats, or Barley

50 Effect of 2,4-D on winter barley at Columbus, Ohio. Shaw, Warren C. and Willard, C. J. Ohio No. 1 winter barley was treated with the triethanol amine salt and the butyl ester of 2,4-D at 0, 1/4, 1/2, 3/4 and 1 pound per acre, acid equivalent, on March 30, when it was 6 inches tall; April 17, 10 inches tall; May 5, 2-joint stage; and May 20, in full bloom. The experiment was a randomized block design, with three replications. The plots were 10' x 70', and were treated with an accurately calibrated experimental boom sprayer with a source of compressed air to maintain a constant pressure. The butyl ester at one pound on May 5 delayed heading for about a week. There was no visible effect of any other treatment. These one pound plots could not be distinguished a short time after blooming. Yields were determined by taking 3 samples of one square yard each from each plot. There were no significant differences in yield between materials, dates of treatment or rates of treatment. Weeds were not a factor in the yields. (Contribution of the Ohio Agri. Exp. Sta.)

51 Effect of 2,4-D as a selective herbicide on Pawnee winter wheat. Woestemeyer, V. W. Duplicate square rod plots of Pawnee wheat were sprayed with amine, salt and ester types of 2,4-D at rates of one-eighth to one pound per acre at the fully tillered (April 22-26) and post bloom (May 28) stages, and with from one-half to three pounds per acre at the late boot stage (May 12). The experiment was conducted during an unusually dry spring on land infested with field bindweed and cheat. Only minor differences in yield occurred on plots receiving one pound or less of 2,4-D in any of the three types. On nearly all plots sprayed in the boot stage, yields were slightly lower than on plots receiving the same treatment at the other stages. Two and three pound rates at the boot stage caused reductions in yield up to fifty-five and sixty-four percent respectively. Test weight was essentially the same on all plots. Rates of one pound or more at tillered and boot stages caused delayed maturity of from two and four days for salts and esters, respectively, at one pound per acre, to ten days for three pounds of ester. Wheat has a tendency to lodge where one pound or more of 2,4-D per acre of any type was used at the first two stages. The effect was more pronounced with the heavier rates. Straw and cheat on these plots turned a dull brown color at maturity. Fair to good control of bindweed through harvest was obtained on most plots receiving one-half pound or more of 2,4-D not earlier than April 26, or after full emergence of bindweed. (Contribution of Kansas Agri. Exp. Sta.)

52 Effect of fall treatments of 2,4-D on Pawnee wheat. Elder, W. C. Pawnee winter wheat was planted September 2, 1947, in a bindweed infested area. Thirty days later (early tiller stage) the wheat was treated with sodium salt and butyl ester of 2,4-D at 1/2, 1 and 2 pounds acid equivalent per acre using a randomized block design with four replications. There was plenty of moisture for early growth but at time of treatment the soil was dry. Very dry growing conditions continued throughout the season until a short time before maturity. All treatments caused some onion leaf appearance on the wheat, especially in the heavy applications. All treatments caused some poor head exsertion. A slight delay of maturity was noticeable in the 1 lb. ester and 2 lb. salt plots. The 2 lb. ester plots reduced tillering and delayed maturity one week. Because of this delayed maturity these plots had more favorable

growing conditions and it appeared that yield would be increased over all other plots in the experiment. However, at time of maturity the 2 lb. ester plots seemed to die instead of maturing normally. This condition at maturity caused shrunken kernels of wheat. There were no significant differences in yields between the treatments. All treatments, except the 2 lb. ester, gave slight increases in yield over control plots. The 2 lb. ester plot yields were just under the check yields. A heavy growth of bindweeds was found in all check plots at time harvest. A few bindweeds were noticeable in the 1/2 lb. salt plots, but all other treated plots were practically free of the weed. (Contribution of the Oklahoma Agri. Exp. Sta.)

53 Effect of 2,4-D on Pawnee winter wheat. Elder, W. C. Because of dry weather Pawnee wheat was not planted until December, 1947. There was sufficient moisture for germination before January 1, 1948, but it was unusually dry until a short time before maturity. All treatments were made during this dry period. Treatments consisted of 0, 1/4, 1/2 and 1 pound of 2,4-D acid equivalent per acre of sodium salt, triethanol amine salt and ethyl ester. Applications were made in 40 gallons of water per acre on March 29 (full tiller), April 21 (joint) and May 7 (early boot stage). Randomized block design was used with 4 replications. Yields were calculated from 4 drill rows spaced 7 inches apart and 20 feet long. No weeds were present at any time. All yields, including control, were practically the same. There were no significant differences in yield between rates and types of 2,4-D or dates of treatment. There was no evidence of deformities in any of the treated plots. Chemical analysis showed protein of the wheat to be the same for all plots. (Contribution of the Oklahoma Agri. Exp. Sta.)

54 2,4-D as a selective herbicide in winter wheat. Phillips, W. M. In 1948 a sodium salt, an ester and an ester plus 5 quarts of oil per acre applied as a mechanically agitated oil-water mixture were sprayed on winter wheat at four different stages of wheat growth. The rates and stages of application were 1/4, 1/2 and 1 lb. 2,4-D per acre at the pre-fully tillered stage, 3/4 headed stage and ten days before harvest. At the second joint stage 1/8, 1/4, 1/2, 3/4 and 1 lb. of ester and 1/4, 1/2, 1 and 1 1/2 lbs. of sodium salt were used. No distortion of the plants was noted from any application and heads emerged normally. Some annual weeds were present in the plots but removal of the weed competition did not appreciably increase the yields over the untreated plots. No serious reduction of yield occurred from any of the treatments; however, the higher rates of esters applied at the second joint and 3/4 headed stages had a tendency to depress the yield slightly. The 1/2, 3/4 and 1 lb. of ester at the second joint stage delayed the development of the wheat so that it headed from 4 to 7 days later and ripened about 3 days later than the other plots. One pound of ester applied 10 days before harvest caused some lodging of the wheat. Germination was normal on the wheat from all plots with possible exception of the 1 lb. of ester plus oil treatment at the 3/4 headed stage. This treatment averaged only 6% less than the no treatment. (Contribution of Bureau of Plant Industry, Soils and Agricultural Engineering, Division of Cereal Crops and Diseases, Hays, Kansas.)

55 Controlling annual weeds in winter wheat. Phillips, W. M. In 1948 a sodium salt, an ester and an ester plus 5 quarts of oil per acre applied as a mechanically agitated oil-water mixture were sprayed on winter wheat at four different stages of wheat growth. The rates and stages of application were 1/4, 1/2 and 1 lb. 2,4-D per acre at the pre-fully tillered stage, 3/4 headed stage and ten days before harvest. At the second joint stage 1/8, 1/4, 1/2, 3/4 and 1 lb. of ester and 1/4, 1/2, 1 and 1 1/2 lbs. of sodium salt were used. Esters

at 1/2 lb. or more gave satisfactory weed control at the first two stages with 1/4 lb. only slightly less effective than the higher rates. 1/8 lb. of ester gave only about 45% kill of weeds. The esters applied at the 3/4 headed stage were not so effective as when applied earlier but did control the weed to the extent that they would not be a problem in harvesting. One pound of sodium salt was no more effective than 1/4 lb. of ester at the first two stages and the salt was ineffective at any rate on the later dates. The pre-harvest application did not have time to give complete kills but the higher rates of ester did cause some drying of the weeds. The addition of oil seemed to have little effect on the yields of wheat or on the control of weeds. (Contribution of the Bureau of Plant Industry, Soils and Agricultural Engineering, Division of Cereal Crops and Diseases, Hays, Kansas.)

56 Effect of 2,4-D on annual weeds and winter wheat when applied by airplane. Phillips, W. M. Spray applications of the methyl, isopropyl, and butyl esters at 1/4 and 1/3 lb. per acre in one gallon of diesel fuel, 1/4 and 1/3 lb. isopropyl ester in 2 gallons of water, 2/3 lb. amine in 5 gallons and 2 gallons of water and 1/2 lb. amine in 5 gallons of water were made May 21, 1948, on winter wheat in the late boot stage. Four replications were used. No significant change in yield was obtained from any of the treatments as compared to the no treatment plots. The value of controlling the weeds, however, was evident at the time of harvest. Plots which were weed free were combined in less than half the time required to cut the unsprayed plots. The quality of grain from the clean plots was superior to that which was harvested from the weedy plots. Weed control was nearly equal for the various esters applied in oil, none having a distinct advantage over another. 1/3 lb. appeared to be enough more effective than 1/4 lb. to warrant the slight additional cost. None of the amine treatments were as effective as the ester, although 2/3 lb. amine in 5 gallons of water gave satisfactory weed control and was nearly equal to the esters. It was evident that 2 gallons of water did not result in sufficient coverage to give adequate weed control either with the ester or the amine. Some of the plots sprayed with 2 gallons of water were still badly infested with weeds at harvest. Germination of all samples was excellent. (Contribution of Bureau of Plant Industry, Soils and Agricultural Engineering, Division of Cereal Crops and Diseases, Hays, Kansas.)

57 Effect of 2,4-D and 2,4,5-T on Pawnee winter wheat at four stages of growth. Klingman, Dayton L. Weed-free Pawnee winter wheat was sprayed at Lincoln, Nebraska, in 1948 with 2,4-D ester at 10 rates of application from 0 to 2 lbs. and at 4 stages of growth; jointing, early boot, late boot and headed. 2,4-D amine was applied at two rates and 2,4,5-T at one. The wheat grew vigorously throughout the period in which treatments were made. Average yields of 24 replications, including all dates, were as follows: check (untreated, weed-free) 48.8 bu. per acre; ester of 2,4-D, 1/8 lb. per acre 45.7 bu., 1/4 lb. 46.2 bu., 1/2 lb. 45.0 bu., 3/4 lb. 41.4 bu., 1 lb. 39.8 bu., 2 lbs. 33.4 bu.; amine salt of 2,4-D, 1/2 lb. 46.2 bu., 1 lb. 45.3 bu.; ester of 2,4,5-T, 1 lb. 40.3 bu. Standard error of the mean difference for the above yields is 1.5 bu. Most injury to the wheat occurred when sprayed in the early boot stage (40.3 bu.), followed by headed stage (41.9 bu.), late boot stage (44.6 bu.), and jointing (46.0 bu.). Of other factors measured that of number-of-kernels-per-head was affected more than any other. The last 3 dates of treatment averaged significantly lower in number of kernels than the check, with the lowest number for the early boot stage followed by the headed, late boot, and jointing stages. The average number of spikelets per head was also reduced. Differences from the check were significant at the 1% level in the early boot stage. Treatments on

the other dates were not significant. Other factors affected significantly were weight per bushel, date headed, and height in inches. Factors not affected significantly were number of heads per foot and number of tillers per foot. The germination percentages ranged from 89.4 to 91.5% based on duplicates for each of 24 replications. The check germinated 89.7%. (Contribution of Div. of Cereal Crops and Diseases, B.P.I.S.A.E., U.S.D.A.)

58 The control by 2,4-D of annual and winter annual stinkweed in winter wheat. Cardner, A. C. A butyl ester and triethanol amine salt of 2,4-D was applied at three rates, viz., 4, 8, and 12 ounces acid equivalent per acre on stinkweed (Thlaspi arvense) in Karkov winter wheat. Treatment was done in early spring when the wheat and the over-wintered stinkweed were still in the rosette and the spring-germinated stinkweed in the seedling stage. A dry spring and early summer made for keen competition for moisture between the wheat and weeds. 2,4-D treatment did not affect the maturity of the wheat but caused lengthening of straw possibly due to the elimination of weed competition. There was no deformation of the wheat heads by any treatment. Weed control was 85, 95, and 100 percent effective by the ester and 45, 80, and 90 percent effective by the amine for the 4, 8 and 12 ounce dosages, respectively. Grain yields were promoted 21, 26, and 29 percent by the ester and 13, 15, and 25 percent by the amine for the 4, 8, and 12 ounce rates, respectively. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

59 The effect of 2,4-D compounds on the control of onions and garlic in wheat. McKibben, G. E. and Fuelleman, R. F. Wild onion and garlic (Allium sp.) growing in winter wheat, were treated with the butyl ester and sodium salt compounds of 2,4-D at rates of 3/4 and 1 1/2 pounds of acid equivalent per acre on April 4, 1948. The wheat variety was Indiana Red Chaff, a variety well adapted in southern Illinois. Atmospheric temperature was 51° F. Germinated onion and garlic seedlings were killed by both compounds at the different rates of application, but a sufficient number of ungerminated onions and garlic bulbs and seeds or bulblets remained in the soil to produce a good stand. Sample grain yields indicated a depressing effect from the 1 1/2 pound applications of ester; however, the 3/4 pound applications of ester and 1 1/2 pound application of sodium salt, both gave increased yields of wheat as compared to the check. The number of bulblets contained in the wheat seed were reduced by approximately 50 percent in all treatments. (Contribution of the Department of Agronomy, University of Illinois Agricultural Experiment Station.)

EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CORN AND SORGHUMS.

REGIONAL SUMMARY

By: Oliver C. Lee, Purdue University

It is apparent from all reports received that the various varieties and strains of corn vary in their tolerance to 2,4-D. Some are injured by comparatively light dosages while others will withstand much heavier applications without serious damage, regardless of stage of growth when sprayed. There appears to be a difference in opinion as to the stage of growth of corn, when corn is most tolerant to 2,4-D. It might be concluded that under identical growing conditions larger corn, 10 inches or taller, is more tolerant than smaller corn. This year in Indiana small corn, 3 inches in height, growing slowly because of cool, dry weather, was found to be more tolerant to 2,4-D than larger corn sprayed during a period that might be considered ideal corn growing conditions. Growing conditions appear to be a factor affecting tolerance of corn. Kramer and Willard reported that spraying corn with 2,4-D just before tasseling adversely affected seed set. Spraying had no effect on the progeny when seed was produced.

Some degree of injury regardless of dosage can be expected as indicated by symptoms of brittleness, lodging, stalk curvature and fasciation of brace roots. Such damage may or may not be reflected in yields depending upon severity of damage and upon the ability of the corn to outgrow the effect. Generally speaking, the degree of injury to corn was found to be in direct proportion to the dosage of 2,4-D applied. However, differences of small dosages up to 0.5 pounds per acre were slight. Damage from heavier dosages were more often reflected in reduction in yields. This was especially true when the "Ester" type of 2,4-D was used.

It is apparent that the use of 2,4-D as a selective herbicide <u>alone</u> is not the answer to weed control in the corn field. Cultivation is necessary to destroy grassy weeds and on some soil types it may be necessary for desired soil tilth. When broadleaf weeds are a serious problem, a combination of spraying and cultivation may prove to be the answer.

Elder reported varieties of sorghums vary in their tolerance to 2,4-D. Dwarfing was noted of one variety due to spraying. Deformed brace roots were noticeable in all varieties when 1 pound of 2,4-D per acre was applied.

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Some degree of injury regardless of dosage can be expected as indicated by symptoms of brittleness, lodging, stalk curvature and regulation of brace roots. Such injury may or may not be reflected in yields depending upon severity of damage and upon the ability of the corn to outgrow the effects. Generally speaking, the degree of injury to corn was found to be in direct proportion to the dosage of 2,4-D applied, however, differences in yield for rates up to 0.5 pounds per acre were slight. Damage from heavier dosages were more often reflected in reduction in yields. This was especially true when the "ester" type of 2,4-D was used.

It is apparent that the use of 2,4-D as a selective herbicide should be more an answer to weed control in the corn field. Cultivation is necessary to destroy grassy weeds and on some soil types it may be necessary for proper soil tilth. When broadleaf weeds are a serious problem, a combination of spraying and cultivation may prove to be the answer.

While different varieties of sorghums vary in their tolerance to 2,4-D. Spraying had no effect [illegible] of the variety due to spraying. [illegible] plants were more susceptible in all varieties when 1 pound of 2,4-D per acre was applied.

ABSTRACTS

60 Effect of several growth regulating materials applied at herbicidal concentrations on corn growth and yield. Buchholtz, K.P. The yellow dent single hybrid R3 x M13 was sprayed when about 20 inches high with the sodium salt (1), amine (2) and butyl ester (3) preparations of 2,4-D and the isopropyl esters of 2,4,5-T (4) and MCP (5). Applications were made at the rates of 0.25, 0.5 and 1.0 pounds per acre using the equivalent of 20 gallons of water as a top spray. All treatments were replicated 4 times and statistical analyses of the data were made. The plots were kept weed free throughout the season. Stalk bending indexes were obtained 4 weeks after treatment. An index of 0 denoted no bending and 5 complete prostration of all plants. Plots treated with (3) had an average bending index of 1.55 which was significantly higher than that obtained with any of the other materials. Material (4) gave an index of 0.70 which was significantly lower than any of the other materials. Materials (1), (2) and (5) gave intermediate indexes of 1.16, 1.22 and 1.20 respectively and were not significantly different from each other. In every case there was an appreciable increase in stalk bending with increases in rate of application. Grain yields of plots treated with materials (1), (2), (3), (4) and (5) averaged 55.2, 54.0, 52.8, 51.3 and 52.5 bushels per acre respectively, with check yielding 58.4 bushels. None of these differences obtained were significantly less than check. It appears that corn will develop good yields of grain after being treated with 2,4-D provided that the bent stalks are not broken by cultivation or weather hazards. (Contribution of the Dept. of Agronomy, Univ. of Wisconsin, Madison, Wis.)

61 Effect of date and method of 2,4-D application on corn injury and yield. Buchholtz, K.P. A yellow dent single hybrid R3 x M13 was given top sprays at the 2, 5, 10, 20, 30 and 40 inch growth stages with an amine preparation of 2,4-D applied at the rate of 1 pound per acre of the acid equivalent using water equal to 20 gallons per acre. At the 20, 30 and 40 inch growth stages side applications were also made in such a manner as to avoid the topmost 4 or 5 leaves of the corn plant. All applications were replicated 4 times and statistical analyses of the data were made. Stalk bending indexes were obtained at the tassel stage and are expressed on a 0-5 scale, 0 representing no bending and 5 completely prostrate plants. Bending indexes of 0.29, 0.31, 1.48, 2.26, 1.88 and 2.20 were obtained for the applications made at the 2, 5, 10, 20, 30 and 40 inch growth stages respectively. The indexes obtained from plots treated at the 2 and 5 inch stages are not significantly greater than check, all other treatments being significantly greater. The two methods of application did not significantly alter the degree of stalk bending. Top spray applications at the 20, 30 and 40 inch stages produced an average index of 2.10 while side spray applications on these dates gave an average index of 2.12. Yields of grain sprayed at the 2, 10, 20 and 40 inch stages were significantly less than check, being 76.0, 68.1, 70.2 and 76.7 bushels per acre with a check yield of 81.1 bushels. Yields of plots treated at the 5 and 30 inch stages were 83.2 and 76.7 bushels per acre respectively. The average grain yield for all plots top sprayed at the 20, 30 and 40 inch stages was 74.7 while plots side sprayed on these dates gave an average yield of 76.1 bushels. (Contribution of the Dept. of Agronomy, Univ. of Wisconsin, Madison, Wis.)

62 The tolerance of corn to various formulations and concentrations of 2,4-Dichlorophenoxyacetic acid. Buckley, G.F.H. To test the tolerance of corn to various formulations and concentrations of 2,4-D acid, four corn hybrids, Harvic 300, Pioneer 322, Pride D66 and Canada 696 were used. Sodium salt, amine and propyl ester formulations were sprayed on the corn and ground at the rates of 1/8, 1/4, 1/2 and 1 pound of 2,4-D acid per acre. The plots were 1 sq. rod in size, randomized and replicated three times. One application of spray was given each plot when the corn was between 8 inches and 12 inches high. The effects of the spraying was noticeable within 24 hours, though the greatest amount of stalk bending was observed on the third day. Bending was most evident in the plots sprayed with the higher concentrations of 2,4-D, especially in those sprayed with propyl ester base at rates of 1/2 and 1 pound per acre. Later, as the brace roots appeared they were observed to be grown together forming a thickened disc just above the ground level. In general, the distortion of plants was less in evidence in hybrids Harvic 300 and Pride D66 than in Pioneer 322 and Canada 696. However, all plots recovered completely within six weeks after spraying. No correlation was obtained between the yield of shelled corn and either the formulation of 2,4-D acid or the rates of application. The hybrids showed satisfactory tolerance to the 2,4-D formulations at concentrations up to 1 pound per acre. (Contribution of the Dominion Experimental Station, Harrow Ontario; Experimental Farm Service, Dominion Department of Agriculture.)

63 Post-emergent treatment of corn with 2,4-D, controls broadleaf weed species. Fuelleman, R.F. and F.W. Slife. Replicated plots of corn, treated with 1/2 and 1 1/2 pounds acid equivalent of butyl ester, amine and sodium salt of 2,4-D and 2,4,5-T, dust and solution were compared with cultivated and uncultivated check plots. The corn was planted on newly turned sod on June 6. Because of dry weather, germination was not uniform; this resulted in corn of varying heights at the time of spraying on June 29. Grass weeds and annual broadleaf species in abundance infested the plots. Broadleaf species were all destroyed by the various materials used in both concentrations. Grass weed species were partially controlled by the heavier concentrations when compared with the check plots; however, a single cultivation on July 1 gave the best control based on number of weeds per sample area. On uncultivated plots, both treated and untreated, competition from grass weeds caused a reduction in yields. (Contribution of Ill. Agr. Exp. Sta.)

64 Control of weeds in corn with 2,4-D in northern Illinois. Fuelleman, R.F. and F.W. Slife. A comparison was made of the effect of a single cultivation of corn when 30 inches in height, with and without 2,4-D treatment; with treated, uncultivated corn, and check plots without cultivation or treatment. The principal weed species were cocklebur (Xauthium sp.), hedge bindweed (Convolvulus sp.), smartweed (Polygonum sp.) ground cherry (Physolis sp.), Canada thistle (Cirscium), foxtail (Setaria sp.)and barnyard grass (Echinochloa sp.). Ester and amine compounds of 2,4-D were used at 0.6 and 1.3 pounds of acid per acre. Considerable twisting and bending of corn plants occurred. Extensive proliferation of brace roots was evident and plants subsequently dug up displayed a smaller fibrous root system. All broadleaf weeds were destroyed on all sprayed plots. Cultivation plus spraying resulted in plots almost free of both grass and broadleaf weed species.

Plots sprayed but uncultivated were very foul with grass weeds. Uncultivated, unsprayed plots were almost completely dominated by both narrow and broadleaf weeds. Yields of corn range from a few bushels on uncultivated, untreated check plots to 85 bushels on cultivated plots. These are estimates since yields have not been tabulated at this writing. (Contribution of Ill. Agr. Exp. Sta.)

65 Results from Northern Illinois Crop Experiment Field with post-emergent 2,4-D - Materials of corn - 1948. Fuelleman, R.F. and F.W. Slife. A single variety of hybrid corn, planted at the Northern Illinois Crop Experiment Field was used. Replicated plots were treated, when 24-30 inches tall, with 0.3, 0.6, and 1.3 pounds of butyl ester and amine acid equivalent of 2,4-D. Cultivated and uncultivated plots were used in the comparison. In addition, a series of plots were treated with 0.3, 0.6 and 1.3 pounds of butyl ester of 2,4-D, when the corn was 6 inches tall. Good control of broadleaf weed species was obtained with all concentrations of 2,4-D materials. These results indicate that low concentrations of 2,4-D are as effective and more economical than higher concentrations with respect to broadleaf weed species. Grass weeds were not controlled. On treated uncultivated plots, grass weeds population increased because of lessened competition resulting from the absence of broadleaf species. Yields show some variation, however; they indicate that a single cultivation on June 20 was as effective within the limits of error as 2,4-D plus cultivation. Considerable proliferation of brace roots occurred on 2,4-D treated plots; also, at maturity treated plots showed more breaking over of tops than untreated plots. (Contribution of Ill. Agr. Exp. Sta.)

66 Post-emergence treatments of sweet corn with 2,4-D. Hernandez, T.P. Post-emergence treatments using 0.5 and 1 pound of 2,4-D per acre were applied 24 days after the corn (Golden Cross Bantam) was planted when it was approximately 6 inches tall. Also, 0.25, 0.5 and 1 pound of 2,4-D acid equivalent per acre were applied 35 days after the corn was planted when it was approximately 18 inches tall. Weeds were removed from all plots by cultivation and hoeing before large enough to cause competition with the sweet corn. The broadleaf weeds present were pigweed (Amaranthus retroflexus), Lamb's quarter (Chenopodium album) and purslane (Portulaca oleracea). The grasses were foxtail (Separia sp.) and witchgrass (Panicum capillari). The treatments applied 24 days after planting gave a reduction in the number of broadleaf weeds of approximately 74 per cent, and those applied 34 days after planting gave a reduction in number of broad-leaf weeds of 56 to 74 per cent. Treatments gave little or no reduction in the number of grasses. No significant reduction in yield of sweet corn resulted from any of the 2,4-D treatments. (Contribution of Dept. of Horticulture, University of Wisconsin, Madison, Wis.)

67 Response of corn varieties and hybrids to 2,4-D treatments. Holden, Chas. A. Jr., Brooks, James S. and Elder, W.C. Sixteen varieties and hybrids of corn representative of those adapted to Oklahoma were planted in twenty-hill plots. Rows were 42 inches apart and hills 40 inches apart in the rows. The hills were thinned to a uniform stand of two plants each. All plots were cultivated once. Subsequent lodging prevented further cultivation other than by hoeing. Treatments consisted of

0.5, 1.0 and 1.5 pounds of ester type 2,4-D in 40 gallons of water per acre. The 2,4-D was applied as a spray above the plants when they were 22-26 inches high. The applications were made under favorable weather conditions and the corn was growing rapidly. All treatments were replicated four times. Heavy showers fell within eight hours after spraying was completed. Proliferation of the brace roots and bending and breaking of the stalks were common. Lodging was noticed in all plots but was most severe at the 1.0 and 1.5 pound levels. Average yield of all control and 0.5pound plots was similar. The 1.0 pound treatment reduced yields 15.8% and the 1.5 pound treatment 24.6% as compared with the control plots. Apparently there was a slight differential response between these varieties and hybrids to the various treatments. (Contribution of Okla. Agri. Exp. Sta.)

68 Stalk lodging in inbred lines of corn caused by 2,4-D spray during flowering. Jugenheimer, R.W., F.W. Slife, and R.F. Fuelleman. Spraying inbred lines of corn with 2,4-D solution during flowering caused extreme differences in lodging. The material included 160 inbred lines from 15 states and the United States Department of Agriculture. Most of these lines are widely used in the hybrid corn programs in the corn belt. The plants were sprayed with 1/2 pound of amine acid in 100 gallons of water per acre. The application was made with a small hand sprayer on July 13, 1948, when most of the lines were tasseling. Each plot consisted of 2 hills with 3 plants per hill. Two plots of each line were sprayed, making a total of 4 hills or 12 plants per line. On July 24, the plants were graded for lodging. The amount of lodging was graded as follows: 1, no lodging; 2, light lodging; 3, average lodging; 4, more than average lodging; and 5, very bad lodging. The percentage distribution of the lines was as follows:

Grade	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Perct. of lines	0	3.5	4.5	7.5	10.5	24.5	28.5	13.5	7.5

A difference of 1.5 between any 2 lines was significant at the 1 per cent level. The following lines graded 2.0 or less and were most resistant to lodging: A111, A116, A158, A12, A340, A334, Os420, Ill.HY2, K63, KyS, K201C, B10, and CI.21E. The following lines graded 5.0 and lodged badly: A7, Os426, L289, Ind.H5, Mo.2RF, Iowa 159, Ind.33-16, Ky.39, Ky.58, CI.187-2, Ki48 and CI.5. The land was free of weeds at the time of spraying; the application, however, fairly well controlled the weeds that germinated after the application of 2,4-D spray. (Contribution of the Ill. Agr. Exp.Sta.)

69 Effect of 2,4-D treatment on the progeny of two inbred lines of corn. Kramer, N.W. and C.J. Willard. In 1947, two inbred lines of corn, Ohio 51A and Iowa Os420, were increased by self-pollination under treatments with two pounds acid equivalent per acre of the isopropyl ester of 2,4-D at seven stages from pre-emergence to ten days after pollination. No seed could be produced on either line following treatment just before tasseling. In 1948 the seed lots produced were planted in a standard corn performance test in four replications. No differences in the progeny due to the effect of treatment could be observed. Yield data will be taken. (Contribution of the Ohio Agr. Exp. Sta.)

70 Effect on the performance of two corn hybrids of post-pollination treatment of seed plants with 2,4-D. Kramer, N.W., and C.J. Willard. Seed of two corn hybrids, Ohio W36 and Iowa 306, was produced by reciprocal hand crossing in paired rows in 1947. Treatments were made on two dates, three and ten days after pollination, with the isopropyl ester the sodium salt of 2,4-D, at 500, 1,000 and 2,000 p.p.m. The seed plants were thoroughly wetted with the solutions. In 1948, seed from the 24 treated lots and from untreated lots was planted at Columbus, Ohio, in a standard corn performance test design with four replications. During the growing season no differences could be observed among the treated lots or between the treated and the untreated lots. Yields will be taken on this test. (Contribution of the Ohio Agr. Exp. Station.)

71 Response of corn to spraying in combination with cultivation. Lee, Oliver C. Corn planted on a Crosby silt loam was treated as follows: (1) Cultivated when 6 inches in height, sprayed with 0.5 pounds of 2,4-D (amine salt) when 12 inches in height; (2) Sprayed when 12 inches in height, no cultivation applied; (3) Cultivated twice at 6 and 24 inch heights. Plots receiving no cultivation were heavily infested with grassy weeds but relatively free from broadleaf weeds. Yield of corn averaged 66.0 bushels per acre. Plots sprayed and cultivated and cultivated only were relatively free from all weed growth. The average corn yield on these were 81.6 bushels from those receiving cultivation alone. (Contribution of the Dept. of Botany and Plant Pathology, Purdue University, Lafayette, Ind.)

72 Response of corn to various rates of application of three formulations of 2,4-Dichlorophenoxyacetic acid. Lee, Oliver C. Replicated plots were sprayed when corn was 12 inches in height with 0.25, 0.5, 0.75, 1.0, 1.5 and 2.0 pounds of 2,4-D per acre, using a sodium salt, amine salt and an ester. Dosages of .75 pounds per acre and more produced marked brittleness and lodging of corn plants. In the case of the ester type of 2,4-D, some leaf burn was noted as well as pinched or tightly rolled top leaves. Yield determinations will be made. (Contribution of the Dept. of Botany and Plant Pathology, Purdue University, Lafayette, Ind.)

73 Differential tolerance of corn hybrids to 2,4-Dichlorophenoxyacetic acid. Lee, Oliver C. Replicated plantings of 20 double crosses, 36 single crosses and 31 inbreds were sprayed with 2,4-D when approximately 12 inches in height, at the rates of 0.5 and 1.5 pounds per acre. A wide range of tolerance was observed, when measured in terms of lodging, brittleness and fasciation of brace root development. Among those most seriously injured included all varieties of white corn. Although greater injury to corn was noted from the heavier dosage, the difference in tolerance of varieties was pronounced when sprayed with 0.5 of a pound of 2,4-D per acre. (Contribution of the Dept. of Botany and Plant Pathology, Purdue University, Lafayette, Ind.)

74 Response of corn to 2,4-Dichlorophenoxyacetoc acid when applied at various stages of growth. Lee, Oliver C. Corn was sprayed when 4, 8, 12 and 30 inches in height. An amine salt of 2,4-D was used at rates of 0.25, 0.5, 0.75 and 1.5 pounds per acre. The degree of injury to corn as measured by brittleness, lodging and curvature of stalks increased with

rate of dosage. 12 inch corn appeared to be more susceptible to injury than 4, 8 or 30 inch corn in this experiment. Yield determinations will be made. Note: 4 and 8 inch corn was sprayed during a drouth period. Corn at that time was growing very slowly. At the time the application of 2,4-D was made to 12 inch corn, moisture was plentiful, temperature and humidity was above 90 degrees. Corn was growing rapidly. (Contribution of the Dept. of Botany and Plant Pathology, Purdue Univer., Lafayette, Ind.)

75 Effect upon corn of post-emergent treatments with 2,4-Dichlorophenoxyacetic acid for weed control. McCall, G.L. and J.W. Zahnley. Post-emergent treatments were made on weeds in Pride of Saline, an open pollinated variety of corn at 1/4, 1/2 and 3/4 lbs. per acre, acid basis, with monohydrate sodium salt, triethanol amine and isopropyl ester on June 11 and again on June 26 when the corn was 8 to 12 and 26 to 32 inches respectively. The earlier treatments gave better weed control than did those applied at a later date but also affected the corn to a greater extent. Weed control was poor due to the large amount of crab grass and Browneyed Susan present. Post-emergent treatments in general gave poorer weed control, caused greater abnormal growth responses and in general yielded less corn than did pre-emergent treatments. The cultivated checks yielded more than any other treatment. (Contribution of Kansas Agri. Exp. Sta.)

76 The effect of 2,4-D on hybrid corn strains yields. McKibben, G.E. and R.F. Huelleman. A regular series of some 60 corn strains planted in a corn performance test at the Dixon Springs Station was used for this test. Amine, ester and sodium salt compounds with and without cultivation were compared with cultivated and uncultivated checks. Good control of broadleaf species was obtained with all concentrations of 2,4-D. Normal cultivation was the basis for comparison, and when fields are badly infested with grass weed species, cultivation is still the most efficient tool of control. Cultivation plus 2,4-D in heavy concentrations gives good control of all weeds, but causes some damage to corn. Lighter concentrations of 2,4-D plus cultivation, while less efficient in controlling grass weeds, did not damage the corn. Since this field has not been harvested, being composed of late maturing strains, the data cannot be included at this time. (Contribution of Ill. Agr. Exp. Sta.)

77 Comparative effects of complete coverage and the use of drops in applying 2,4-D sprays to corn. Shafer, N.E. and Wolfe, H. A single corn hybrid was sprayed with a knapsack sprayer July 10, 1948. Five gallons per acre were used of a 2 pounds acid per acre solution of the butyl ester. The corn was in the laying-by stage and in such a growing condition that curvature and brittleness were easily obtained from 2,4-D sprays. Plots were 3 rows wide and approximately 150 feet long. All treatments were randomized and replicated 3 times. One-half of the treated plots were sprayed simulating complete coverage by holding the spray nozzles above the corn. The rest of the treated plots were sprayed using drops which brought the spray directly into the row from the side. Ten days after treatment notes were taken on the number of bent or curved stalks, node where bent, and the number of broken stalks. The average number of bent stalks resulting from side treatment was 46 as compared to 18 from over-the-top sprays. Side sprays caused all of the curvature at the first node

whereas top spraying resulted in curvature of the first, second, and third node with diminished frequency and severity in the higher nodes. No broken stalks were noted on any plots. No significant differences in yields could be found. (Contribution of the Dept. of Agronomy, College of Agriculture, Lincoln, Nebraska.)

78 Varietal response of forty corn hybrids to 2,4-D. Viehmeyer, Glenn. The butyl ester of 2,4-D, applied to forty certified and experimental corn hybrids, at the rate of 1/4 lb. of acid per acre, indicated a wide range of degree of tolerance to the herbicide to be present in the material in the test. Response of the plant to the treatment was measured in degree of stem curvature. Measurements were made of 6050 individual plants. These plants were in randomized blocks, replicated four times. In evaluating the data plants showing a curvature of 28 degrees or more were arbitrarily designated as being seriously affected, because such plants often extended into the space between rows where they were subject to breakage from cultivation tools. In the forty hybrids in the test, percentages of seriously affected plants ranged from a low of 1.40% in the most tolerant hybrid to 19.22% in the most susceptible one. The remaining hybrids were distributed in a fairly regular sequence between the two extremes. The entire series showed a mean value of 10.79%. (Contribution of North Platte Sub-Station, University of Nebraska).

79 Response of two size-age classes of hybrid corns to identical dosages of 2,4-D. Viehmeyer, Glenn. Measurements of curvature caused by the application of 1/4 lb. of 2,4-D as a butyl ester to two size-age classes of hybrid corn indicate a significant difference in tolerance between the classes. Measurements were taken on 3350 plants 12" to 18" tall and on 6050 plants 3" to 6" tall. Forty hybrids planted in randomized blocks replicated four times were measured in the trial. Plants showing a curvature of 28 degrees or more were arbitrarily designated as seriously affected since that curvature made many plants subject to possible breakage during cultivation operations. In evaluating results each of the hybrids were measured separately and the percentage of variates falling into the seriously affected classification calculated. From these percentages mean percentages for the two size-age classes were calculated. Thirty-six of the hybrids tested showed the 12" to 18" class as being more seriously affected while in the remaining four the 3" to 6" plants appeared more susceptible. Means of the two classes showed a ratio of 2.16 to 1 in favor of the smaller class of plants, or 23.34% : 10.79%. Field observations of an additional hybrid receiving the same treatment support the conclusion that in general the smaller plants are more tolerant to the dosage used. (Contribution of University of Nebraska Sub-Station, North Platte, Nebr.)

80 Response of sorghum varieties to 2,4-D at one stage of growth. Elder, W.C. and Davies, Frank F. Eight varieties of sorghums were planted in 4-row plots, each row spaced 3 1/2 feet wide and 30 feet long. When the plants were 4 inches high, all plots were hand thinned to uniform stand. Weeds were removed with the hoe when small, and standard cultivation was given throughout the season. When the plants were 10-12 inches high, 1/4, 1/2 and 1 pound of ester type of 2,4-D in 40 gallons of water per acre was sprayed above the plants. All plots were replicated three times. Appli-

cations were made when the sorghums were growing very rapidly under favorable weather conditions that existed throughout the season. At maturity the two center rows of each plot were harvested for yield. Yields were calculated in dry forage for the three forage varieties and bushels of grain per acre for the five grain varieties. Forage yields of commercial Common Sudan and Sumac F.C.I. No. 1712 and grain yields of Ok. No. 1 Darso and Standard Blackhull kafir C.I. No. 71 were not affected by any of the 2,4-D treatments. Atlas C.I.No. 899 and Dwarf kafir 44-14 showed slightly reduced yields only at the 1 pound level. Kaferita C.I.No. 811 yields were reduced 45% by the 1 pound application but was not affected by the 1/4 and 1/2 rates. Resistance Wheatland milo G.C. 38288 was affected by all treatments with reductions of 55% at 1 pound rate, 33% at 1/2 pound rate and 9% at 1/4 pound rate. This variety showed evidence of susceptibility soon after the treatments were applied. All brace roots were deformed and enlarged. There was no bending or breakage of stalks in this variety but the plants were dwarfed and poorly anchored. Evidence of breakage was not apparent in any of the varieties used and only slight bending was noted in Kaferita. Deformed brace roots were noticeable in all varieties at the 1 pound rate. (Contribution of the Okla. Agri. Exp. Sta.)

PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS.

Perennial grasses. Investigation leader, Glenn Viehmeyer

It seems evident from abstracts submitted, from previous work reported and from reports of those now using the herbicide in the field, that perennial grasses are, as a crop, particularly suited to the use of 2-4-D as a herbicide. Since cultivation is out of the que tion in a sod crop, weed control in such crops is limited to chemical control, mowing or to a combination of the two. Perennial grasses, as a class, are among the most 2,4-D tolerant crops. They are, as a rule, little affected by the dosages of 2,4-D needed to control most broad leaved weeds that commonly infest them. While differences in toleran ce between species and between strains within a specie exist such differences are, in general, of minor importance since they do not appear except at dosages far higher than those necessary to control weeds.

From the evidence available, both that submitted by cooperators in abstracts, and that secured from other sources, the most serious limitation of 2,4-D as a herbicide in grass crops appears to be its inability to control the weedy annual grasses. These plants seem to have a degree of tolerance for the herbicide equal to that of their perennial relatives and a study of the reports of those working with the grasses indicates that 2,4-D is no answer to the control of weedy grasses. Indeed such workers agree that, under conditions of heavy infestation of grassy weeds much of the value of 2,4-D is nullified and that in case of extremenly heavy infestation its use may even be detrimental to young perennial grasses. Removal of the broad leaved weeds from mixed weed opoulations frees annual grasses from competition and their more rapid rate of development enables them to outgrow and suppress slower growing perennial species.

From the information at hand it seems that the problem falls into three classifications that should be considered separately; they are (1) established stands of grass, (2) seedling cool season grasses, (3) seedling warm season grasses.

Chemical weed control in established stands of either warm or cool season is now a matter of record. Once well established, most species of grass are so tolerant of 2,4-D that control is simply a matter of using a dosage high enough to control the weed or weeds in question.

Likewise control of weeds in new plantings of cool season grasses presents no particular problem if proper precautions are taken. Cool season grasses can and perhaps should be planted in the fall, if this is done on a well prepared seedbed with sufficient soil moisture seedlings will be well established before weed competition develops. Even where it is necessary to plant in the spring such planting can be done early enough to permit the grass seedling to start before weed competion reaches a peak, and to reach a size where comparatively heavy dosages of 2,4-D are possible without danger to the grass.

Reports from cooperators indicate that weed control in newly seeded warm season grasses is complicated by a number of factors not found in the case of seedling cool season grasses or in established stands. Most of these special problems may be correlated with the fact that warm season species are planted at a time when weed germination and emergence is at a peak. As a result weed competition is often critical and stands may be lost.

In summing up; most investigators agree that warm season grasses should be planted in soil as free of weed seed as possible and that fields badly infested with seed of annual grasses should not be planted until the infestation is cleaned up. Warm season grasses are quite tolerant of 2,4-D in disages sufficient to control broadleaved weeds but that supplementary measures such as mowing may be required if annual grasses form an appreciable percentage of the weed population.

In one case mowing and 2,4-D is reported as giving better control than either 2,4-D or mowing alone where mixed populations were present. Plots receiving the combination treatment giving better yields as measured by amount of top growth than those receiving either 2,4-D or mowing alone.

Attempts at weed control by use of pre-emergence treatment have proven unsatisfactory due to failure of grass seed to germinate well following such treatment.

Preplanting treatments appear to have promise under some conditions if applied far enough ahead of planting. Such treatments have the added advantage of giving a high degree of control of both grassy and broad leaved weeds. However, much is to be learned about pre-planting treatments before they can be recommended for general use. In fact, more information regarding the response of grass crops to 2,4-D is needed before this herbicide can be fully utilized for weed control in grass crops.

PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS.

Abstracts of Results of Individual Cooperators

Perennial Grasses

81 Control of crabgrass with chemicals. Slife, F. W. The following chemicals and combinations of chemicals were used on crabgrass (Digetaria sp.) growing in bluegrass (Poa pratensis) to test their effectiveness as crabgrass killers. I.P.C., I.P.C. and 2,4-D, phenyl mercuric acetate, phenyl mecuric acetate and 2,4-D, I.P.C. and phenyl mercuric acetate, trichloroacetate, arsenic acid, and arsenic acid and 2,4-D. The plots were in an area that had been mowed regularly. The chemicals were applied in August and the blue-grass was still in an active growing state because of frequent rains throughout the summer. A difference was evident in the response of bluegrass and crabgrass to these chemicals: the crabgrass was more susceptible. The most effective control of crabgrass was obtained with phenyl mercuric acetate mixed with 2,4-D. Counts indicate as high as 90 per cent control of crabgrass with this mixture, but bluegrass was injured to some extent. Arsenic acid in these tests destroyed the top growth of crabgrass and caused some injury to bluegrass from which it eventually recovered. (Contribution of Ill. Agr. Exp. Sta.)

82 A comparison of effect of various treatments on seedling warm season grasses. Viehmeyer, Glenn, McDerman, John. A replicated, randomized block planting of warm season grasses was treated at the 6 to 8 leaf stage with 2,4-D acid at the rates of 1/4, 1/2, 1 and 2 pounds per acre as the sodium salt and with 1/8, 1/4, and 1/5 pound asthe butyl ester. Mowed plots were used as checks. Check plots were mowed June 16 at the time 2,4-d applications were made. Both check and 2,4-D plots were mowed July 22. In all cases plots were clipped high enough to avoid cutting the seedling grasses. The dominant weed in all plots was stink grass(Eragrostis ciliansis). Effect of treatment was measured as total yield of dry forage and amount of fruiting culms produced. Five warm season grasses, blue and sideoats gramma, sand love, and switch were included in the test. In the mowed checks no specie produced seed stalks but blue gramma, sideoats gramma and sand love fruited in all 2,4-D plots. The largest number of culms were produced on plots receiving 1 pound of sodium salt or 1/4 pound of ester. Forage yields followed the same pattern.

Reasons for results secured are not clear, some temporary stunting was in direct ratio to the amount of 2,4-D applied whereas increased seed and forage yield occurred at the lower dosage of 1 pound of salt or 1/4 pounds of ester and were apparently in correlation dosage of 2,4-D rather than to the effect of the temporary stunting of the stink grass. It seemed that increased production of some plots could not be charged differences in competition since such differences were measurable. (Contribution of North Platte Sub-station, Uni of Nebr. and Soil Conservation Service.)

83 Results of the use of 2,4-D as a weed control measure in seedling, warm season grasses. Atkind, M. D. Three formulations of 2,4-D were applied at 3 dosages to newly planted fields of Andropogon halii, A. furcatus and Bouteloua curtipendula. Plots of 1 sq. rd. were laid out in triplicate and treatments of 2,4-D acid at the rates of .25, 50, and 1.0 lb. per acre for the amine and sodium salts, and .10, .25, and .50 for the ester were applied. For comparison plots mowed twice during the season, hand weeded once and receiving no treatment were included in the test. Grasses were planted in 36" rows, April 1 to 8. 2,4-D was applied May 27 to June 2. Grass seedlings had reached the 2 to 5 inch stage and had a height of 1 to 5 in. Weed growth was heavy in the bluestem fields with Amaranthus retroflexus, Melilotus officnalis, and Chenopodium alba, predominant in that order. Weed stand was less uniform in the sideoats gramma field with Solanum rostratum, Verbenea bracteata and Amaranthus retroflexus predominant. Nearly complete control of all weeds except Solanum rostrata resulted from application of 1.0 lb of amine or sodium salt and .50 lb. of ester. Medium dosages of .50 of salt or .25 of ester were inadequate for weed control, while the lighter dosages were little better than no treatment. One hand weeding did not give satisfactory control but two mowings compared well with the heavier dosages of 2,4-D. Both hand weeding and mowing had the advantage of supressing such annual grasses as Digitaria sanguinalis, Setaria lutescens and Panicum Capillare which are 2,4-D tolerant. No dosage or formulation of 2,4-D appeared detrimental to the warm season grass seedlings. (Contribution of SCS Nursery, Manhattan, Kansas.)

84 Changes of weed population due to treatment with 2,4-D and possible effect of such changes on seedling warm season grasses. Viehmeyer, Glenn, McDermand, John. During the past three years it has been demonstrated that the elimination of broad leaved weeds from the normal weed population by use of 2,4-D may defeat its object due to the increased competition offered by annual grasses. During the past three seasons this condition has repeatedly occurred in plots at North Platte, and has been reported by others in the field.

In 1946 treated plots were badly infested with barnyard grass and foxtail, this condition was repeated in 1947 and 1948. In 1948 a series of plots were badly infested with stink grass (eragrostis ciliansis, Link) following elimination of broad leaves.

Competition for light and water resulted in reduced stands in cases where the planting was on dry land. In the case of the stink grass supplementary water prevented loss of stand due to drought.

From results here it appears that where soils are heavily infested with seed of vigorous annual grasses the use of 2,4-D for weed control may be inadvisable. Contribution North Platte Substation, Uni of Nebr and SCS Nursery.

85 Response of three warm season grasses to pre-planting, pre-emergence and post-emergence treatments of 2,4-D. Wolfe, Laird G.

In an exploratory experiment, an amine salt of 2,4-D was applied as a spray at the rate of 1.7 lbs. of acid per acre. Three types of application, pre-planting, pre-emergence and post-emercence were made. The Pre-planting treatment was made 4 days before planting, the pre-emergence 4 days afterplanting and the post-emergence 8 days after the grass was up.

Sand lovegrass (eragrostis trichoides), switch grass (Panicum virgatum), and Side oats gramma (Bouteloua cirtipendula) was planted at the rate of 5, 6 and 3 grams of seed per five foot of row respectively.

In this test sand love appeared most susceptible to 2,4-D injury with a stand reduction of 43% by pre-planting, 100% by pre-emergence and 93% by post-emergence treatment. Switch grass was next with reductions of 27%, 68% and 43% for the respective treatments. Side oats gramma appeared most tolerant with reductions of 17%, 62 and 43%.

Throughout this trial it appeared that the elimination of the broad leaved annual weeds resulted in the releasing of the weedy annual grasses from competition and that those weedy grasses offered even more serious competition to the warm season grass seedlings than did the normal mixed weed population of the untreated checks. (Contribution of Soil Conservation Service, Waterloon, Neb)

86 Effect of weed competition on seedling warm season grasses. Viehmeyer, Glenn, McDermand, John. Five warm season grasses, switch grass, (Panicum virgatum), sand love grass (Eragrostis trichoides), side oats gramma (bouteloua curtipendula), blue gramma (B.gracilis) and Indian grass (Sorghastrum nutans) were planted in randomized replicated blocks May 29, 1948. Plots were irrigated through the summer and the dry forage harvest in the fall.

Handweeded plots were kept free of weeds throughout the growing season while mowed plots were clipped twice during the season. Clipping was done with a whirlwind lawn mower set high enough to clear the tops of the seedling warm season grasses. Clipping was done June 16 and July 22.

A heavy stand of stink grass (Eragrostis ciliansis) developed on the clipped plots andoffered severe competition to the perennial species with the result that while the stand was not lost the seedlings were suppressed and far less vigorous than those in the weeded plots.

Removal of all competition by hand weeding gave yield increases of 1379, 812, 778, 1800 and 2428 per cent for switch, sand love, sideoats gramma, blue gramma and Indian grassrespectively over yields of the clipped plots. (Contribution of North Platte Substation and SCS Nursery)

87 The use of 2,4-D as an aid in establishing warm-season perennial grasses. Klingman, Dayton L. Six species of warm-season grassws were planted May 1, 1948, at Lincoln, Nebr. Good stands were obtainedof big bluestem and switchgrass, but because of too deep planting, relatively poor stands of blue grama, sideoats grama, sand lovegrass, and buffalo grass. The ammonium and amine salts and ester formulations of 2,4-D were applied at 1/8, 1/4, 1/2, and 3/4 lb. per acre at the following grass stages: (1) Emerging to 2-leaf, (2) 3 to 5-leaf, (3) 4 to 12-leaf (3 to 5 inchestall). All grasses showed the so-called "onion leaf" condition following treatment but later many of these plants produced normal rhizomes or tillers. In all species theapplication of 3/4 lb. of ester produced a marked increase in the number of inflorescenses as compared with the mowed or unmowed checks. Indeed heading appeared to be directly related to weed control since other treatments with good weed control showed the same response. Buffalo grass was strikingly invigorated by the elimination of weed competition as evidenced by its rapid spread from stolons in treated plots with sparce production of stolons in the checks. A slight increase of weedy grasses was observed in plots where good control of broad-leaved weeds was obtained. In this test 1/2 lb. ester and 3/4 lb. of the salts were required to give practical weed control. (Contribution of Division of Cereal Crops and Diseases, B.P.I.S.A.E., U.S.D.A.)

88 2,4-D for weed control in grasses grown for seed production. Viehmeyer, Glenn. Three years experience using 2,4-D to control weeds in the row of grasses grown for seed indicates that the herbicide is the most practical means of eliminating weeds from such plantings. No evidence of injury to the grass or to the seed harvested has been observed.

Applications of 1/4 to 1/2 pound of acid as an ester or 1/2 to 1 lb. as a salt controls most of the annual species that are troublesome.

Where stands are thin a second application may be needed to control a second crop of weed seedlings.

Intermediate wheat grass (Agropyron intermedium) Tall wheat grass (Agropyron elongatum) and Sand love grass (Eragrostis Trichoides) have been treated as above with good results. (Contribution North Platte Sub-station, Uni of Nebr)

89 The use of 2,4-D as an aid in establishing cool-season perennial grasses. Klingman, Dayton L. Six cool-season grasses (brome, intermediate wheat, crested wheat, orchard, Russian wild rye, and Mandan wi[illegible]ryegrass) were planted April 3 and 5, 1948. Each of three 2,4-D formulations (ammonium and amine salts and ester) were used at 1/8, 1/4, 1/2, and 3/4 lb. acid per acre, plus a mowed check and an untreated check. The herbicices were applied when the grass seedlings were in the (1) emerging to 1-leaf, (2) 2 to 4-leaf, and (3) 3 to 13-leaf stages. Plots sprayed at the first stage had poor eventual weed control (10 to 30%) because weeds emerged after the spraying. Those sprayed in the second stage varied from 40% weed control for 1/8 lb. ammonium salt to 99% for 3/4 lb. ester. Those sprayed in the third stage averaged 52% control for 1/8 lb. ammonium salt and 99% for 3/4 lb. ester. Twice as much amine or ammonium salt was needed to equal the weed kill of the ester. Favorable weather throughout the season resulted in good stands of grasses in all plots, including the weedy checks; however, the grasses treated at the 2 to 4-leaf stage were larger and more vigorous than the others due to freedom from competition with weeds. Injury to seedlings and newtillers resulted at all rates and dates of treatment, the most obvious being the so-called "onion leaf". Prevalence of onion leaf increased with dosage but decreased with age. Little difference was apparent in the reaction of the various species to 2,4-D. (Contribution of Division of Cereal Crops and Diseases, B.P.I. S.A.E., U.S.D.A.)

90 2,4-D as a selective herbicide in established grass stands. C[illegible]rder, A. C. A stand of creeping red fescue sown the previous year and heavily infested with lamb's quarters, dandelion, pappergrass (Lepidium densiflorum) and volunteer sweet clover was sprayed with the butyl ester of 2,4-D at 8, 12, and 16 ounces acid equivalent per acre. The 8-ounce rate was applied in early spring soon after the over-wintered weeds had commenced rapid growth and the spring-germinated weeds were in the seedling stage. The 12 and 16-ounce rates were applied 10 days later when the lamb's quarters and peppergrass were in early bud, the dandelions in full flower, and the sweet clover 6-8 inches tall. The early treatment at 8 ounces gave more effective control of the spring germinated weeds than the later treatments at 12 or 16 ounces. The 8-ounce treatment eliminated lamb's quarters and pappergrass 100 per cent, sweet clover 90 per cent, dandelion 50, and horsetail (Equisetum sp) 40 per cent; while the 16-ounce rate applied 10 days later killed out 100 per cent of the sweet clover, 70 per cent of the dandelions, and 30 per cent of the horsetail. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

Results of Experiments on Pre-emergence Treatment of Corn With 2,4-D and Other Chemicals

Regional Summary

Prepared by R. F. Fuelleman

Pre-emergence treatment of corn with 2,4-D and other chemicals suggests some interesting possibilities for controlling weeds. During 1947, a number of research workers indicated considerable success with this method. Most of the reports showed that relatively large dosages of 2,4-D gave the best results, but that the per acre cost for chemicals was too high to warrant wide acceptance of the method.

From the abstracts and reports received on pre-emergence treatment of corn, it is evident that there was considerable variation in results in 1948. This variation was apparently caused by soil moisture conditions and relatively high atmospheric temperatures at the time of planting. In some cases good control of both broadleaved annual weeds and grass weeds was obtained from pre-emergence treatments made up to the time of corn emergence. Several reports show good control of broadleaved annual weeds and poor control of grass weeds even with larger dosages of 2,4-D. Grass weeds, such as crabgrass (Digitaria sp.), foxtails (Setaria sp.) and the wild millets, particularly the Echinochloa and Panicum species, usually germinate later than most common broadleaved annuals, and germination of these weeds was delayed by lack of surface soil moisture at the normal corn planting time. Most of the broadleaved annuals, including cockleburs, Amaranthus species, etc., germinate before or about normal corn planting time, making them amenable to chemical treatment.

Where comparisons were made, no striking differences in results were apparent from use of the different 2,4-D formulations. Bruner and Hall (see appended abstract), using sodium pento-chlorophenate, Sinox W, and Xanthogen disulfide, have obtained some interesting results.

A study of the abstracts indicates the need to continue and expand the program of research in pre-emergence treatment of corn with 2,4-D and other chemicals.

PROJECT IV PRE-EMERGENCE TREATMENTS WITH 2,4-D and OTHER HERBICIDES TO CONTROL WEEDS IN CORN.

Abstracts of investigations.

1 Surface soil moisture conditions reduce effect of pre-emergence treatments of corn with 2,4-D. Fuelleman, R. F. and F. W. Slife. Pre-emergence treatments of corn with ester, amine, and sodium salt compounds of 2,4-D at Urbana, without cultivation, were effective in reducing the populations of broadleaved weeds in corn to a minimum, but not effective in reducing grass weeds, such as crabgrass (Digitaria sp.), barnyard grass (Echinochloa sp.), lovegrass (Eragrostis sp.), and panic grasses (Panicum sp.). Replicated series of corn plots were treated with 1/3, 2/3, and 1 1/3 pounds acid per acre of ester and amine 2,4-D compounds, respectively, and 1/2, 1, and 3 pounds of the sodium salt, acid equivalent, on May 25, the day of planting. A second series was treated on May 28, three days after planting. Warm, dry weather prevailed for two weeks preceding and one week after planting of the corn. The corn showed no observable effect from the various materials or concentrations of 2,4-D. Yields have not been tabulated as of this date (10-20-48); however, observations do not indicate any marked differences. (Contribution of the Dept. of Agron., Ill. Agr. Exp. Sta.)

2 Low gallonage pre-emergence treatment of corn with 2,4-D at Dixon Springs controls broadleaved weeds. McKibben, G. E., R. F. Fuelleman, and R. J. Webb. In a large field experiment involving both pre-emergence and post-emergence treatment of corn, single and combined, as well as delayed pre-emergence treatments, using low gallonages at 2/3, 1 1/3, and 2 2/3 pounds of acid equivalent per acre, good control of broadleaved species was obtained with all concentrations. No control of grass weeds was obtained at the lower concentrations; instead, a number of grass weeds were larger so that severe competition for light and nutrients has sharply reduced the yields of corn. A combination of pre-emergence and post-emergence treatments with one or two cultivations has given the best results. Weed species involved were chiefly cocklebur (Xanthium sp.), morning glory (Ipoemia sp.), smartweed (Polygonum sp.), crabgrass (Digitaria sp.), and ground cherry (Physalis sp.). (Contribution of the Dept. of Agron., Ill. Exp. Sta.)

3 Pre-emergent treatments with 2,4-D on corn. Elder, W. C. U.S. 13 corn was planted in a clay soil with sufficient moisture for germination. This field was divided into 4 row plots 30 feet long. Immediately after planting, 5 replications each of 1 pound, 2 pounds, and 4 pounds of an ester of 2,4-D in 40 gallons of water per acre was applied. There was no cultivation, and no weeds were removed from these plots. One plot in each replication was cultivated and all weeds removed with a hoe, while another plot was not cultivated and all weeds allowed to grow. The corn came up 6 days after planting, and 2 inches of rain was recorded the eleventh day after planting. Treatments at the 2 pound and 4 pound levels gave reduced stands and vigor of the corn. Annual weedy grasses were partially controlled. A heavy infestation of nut grass and climbing milkweed was not affected by any of the treatments. Several broadleaved annual weeds were controlled by the 2-pound and 4-pound applications; however, annual smartweed was only partially controlled. Yields compared with the cultivated plots where weeds were removed, gave a reduction of 15 percent for the 2-pound ester, 29 percent for the 1-pound ester, 35 percent for the uncultivated and no treatment, and 40 percent for the 4-pound ester. (Contribution of the Dept. of Agron. Okla. Agr. Exp. Sta.)

4 The effect of 2,4-D and contact dinitro on the yield and maturity of corn when applied as pre-emergence sprays at three different dates. Dersoheid, Lyle A. and D. E. Kratochvil. Randomized plots of Sokota 400, 2 rows wide and 10 hills long were treated in triplicate with the triethanol amine salt of 2,4-D and a contact dinitro at the rates of 1, 2, and 4 pounds of 2,4-D acid per acre and 1, 2, and 4 pounds of dinitro-o-sec-amylphenol per acre. Treatments were made at seeding time, 3 days after seeding and 6 days after seeding, when the corn was beginning to emerge. Entire plots were harvested for yield, and moisture samples were taken from two replicates. Yields were calculated on a 15 percent moisture basis and analyzed statistically. Untreated plots were cultivated three times. Treated plots were cultivated when corn was large enough to "lay by," and remaining large weeds were pulled by hand. All treatments made at emergence gave approximately 25 percent control of broadleaved annuals, such as rough pigweed (Amaranthus retroflexus), common ragweed (Ambrosia artemisiifolia), Kochia (Kochia scoparis) and lamb's quarters (Chenopodium album), while about 10 percent of the foxtails (Setaria viridis and glauca) were controlled by the same treatments; no weed control was obtained by earlier treatments. The moisture content of the corn was not affected, indicating that the maturity was not affected. Significant changes in yield due to the application of 2,4-D at any of the three dates were not established statistically, but a significant decrease was obtained from plots treated with the dinitro at the rate of 4 pounds per acre at seeding time, at the 2- and 4- pound rates 3 days after seeding and by all rates at emergence. This study indicates that pre-emergence spraying, as it is now used, is not a dependable method of weed control and that yields may be reduced by using the dinitro. (Contribution of the Dept. of Agron., South Dak. Agr. Exp. Sta.)

5 Pre-emergence treatment of corn with 2,4-D on Brookston silt loam. Lee, Oliver C. .2,4-D (amine salt) at the rate of 3 pounds per acre was applied as a pre-emergence treatment to corn planted on a Brookston silt loam. Weeds were not successfully controlled by the treatment. Dry soil and weather delayed the germination of weed seeds. Weeds emerging shortly after the application of 2,4-D were killed. A partial kill of grasses resulted. Both check and treated plots were cultivated five weeks after emergence of the corn to destroy weeds. No damaging effect to corn plants was noted. Check plots produced an average yield of 83.8 bushels per acre. Those receiving a pre-emergence treatment produced 87.5 bushels per acre. The difference in yield is not significant. (Contribution of the Dept. of Botany and Plant Path., Purdue Univ. Agr. Exp. Sta.)

6 Response of corn to pre-emergence application of 2,4-D--cultivation and combination of the two. Lee, Oliver C. Corn planted on a Crosby silt loam was treated as follows: (1) 2 pounds of 2,4-D acid (amine salt) per acre was applied three days after planting. No cultivation or stirring of the soil was done after seedbed preparation. The plots were free from broadleaf weeds but heavily infested with foxtail and crabgrass. Yield produced was 85.4 bushels per acre. (2) In addition to applying 2 pounds of 2,4-D per acre as a pre-emergence treatment, the corn was cultivated when 12 to 15 inches in height. The plots were relatively free from weeds, including grass at harvest time. The average yield of corn was 94.4 bushels per acre. (3) Weeds were controlled by two cultivations, the first when corn was 6 inches in height, the second at a height of 18 inches. Plots receiving two cultivations produced an average yield of 101.8 bushels per acre. (Contribution of the Dept. of Botany and Plant Path., Purdue Univ. Agr. Exp. Sta.)

7 Pre-emergence treatment of corn with 2,4-D for the control of weeds on muck soil. Lee, Oliver C. Replicated plots of corn planted on muck soil were treated with 2 and 3 pounds of 2,4-D acid (amine salt) per acre three days after planting. The soil at the time of spraying was dry; however, sufficient moisture was present to produce rapid germination of the corn. Weeds (pigweed, cocklebur and annual smartweed) emerging within a period of ten days after the application of 2,4-D were controlled. Grasses (foxtail and crabgrass) were only partially controlled. Cultivation was applied 24 days after emergence of corn to control weeds and grasses. Symptoms of 2,4-D injury to corn was not noted. (Contribution of Dept. of Botany and Plant Path., Purdue Univ. Agr. Exp. Sta.)

8 Pre- and post-emergence weed control in hybrid seed corn. Bruner, H. E. and W. E. Hall. Pre-emergence treatments for weed control consisted of Santobrite (sodium pentachlorophenate) 20 pounds, Sinox W 1 gallon, and Sulfasan (Santhogen disulfide) 5 pounds, all diluted to 100 gallons with water and applied per acre on an M-20 hybrid seed corn plot. The Santobrite and Sinox W gave excellent control of weeds, and their effect persisted over several weeks. Yield and stand counts in the Santobrite plot exceeded that of the check. Sinox W caused some injury and reduction in the stand of corn. The Sulfasan was used at too low a concentration, as subsequent tests showed. Similar results were obtained on a field of K-35 with Santobrite. Another plot, using a combination of Sulfasan, 7 pounds, and Santobrite, 7 pounds, gave excellent pre-emergence weed control. Another section of the same field of K-35 was treated post-emergence with 10 percent Santophen 20 (pentachlorophenol) in aromatic oil emulsified and applied at the rates of 5 and 10 gallons, diluted to 50 gallons with water (per acre). Still another was treated with Santobrite, 20 pounds, and Sulfasan, 10 pounds, each diluted to 50 gallons with water (per acre). The treatment was made with a low pressure sprayer outfit and applied to 16 inches of row, 8 inches on each side of corn. The corn was 4 feet and the weeds--mostly red root, giant ragweed, and smartweed--3 feet tall. Weeds were killed, and very little injury to the corn resulted. (Contribution of the Monsanto Chemical Company, Akron, Ohio.)

9 The effect of pre-emergence 2,4-D on stand and yield of corn at Columbus, Ohio. Aldrich, Richard J., Warren C. Shaw and C. J. Willard. Ohio C38 corn was planted May 27, 1948. The experiment was a randomized block design of 4 replications. The soil was a Miami-Brookston complex with Brookston (dark soil) predominating. Plots were 3 x 10 hills each, with 2 x 10 hills used for stand and yield determinations. The butyl ester of 2,4-D was applied at the time of planting and five days after planting at 1, 2, and 3 pounds of acid equivalent per acre. No cultivation was given any of the plots, and weeds were the major factor in the yield differences. There was some indication that treating five days after planting resulted in slightly better stands and yields than treating on the date of planting. There was no reduction of stand or yield due to any treatment applied five days after planting. The average yield of all treated plots, regardless of time of application, was about 15 bushels per acre more than on the untreated check plots. This increase in yield was the result of almost complete control of weeds, especially lamb's quarter, pigweed, green foxtail, and crabgrass. (Contribution of the Dept. of Agron., Ohio Agr. Exp. Sta.)

10 Pre-emergence treatments with 2,4-D and other herbicides to control weeds in field crops. Bordeleau, R. and F. Coiteux. During 1948 the first test consisted in trying three types of 2,4-D, amine (Weed-Bane), ester (Weed-No-More), and sodium salt (Herbate), at the rate of 1 pound per acre, pure acid basis. The material was applied on silage corn, variety Wisconsin 7, 3 days after sowing. A very slight decrease in weeds was observed over the check. With each type of 2,4-D the yield was very slightly superior to the noncultivated check, which yielded 3.99 tons per acre. The sodium salt secured the lowest yield with 4.33 tons per acre; amine, 4.61 tons; and ester, 4.81 tons. The second test consisted in trying the amine type of 2,4-D on silage corn immediately after and 3, 6, and 10 days after sowing at the following rates, pure acid basis: 1 lb., 2 lbs., and 4 lbs. per acre. The 4-pound quantity yielded 4.21 tons per acre more than the cultivated check (3.99 tons per acre), the 2-pound quantity 4.09 tons more, and the 1-pound quantity 2.99 tons more. The 4-pound quantity did secure the best results. As to time of application, 6 and 10 days after sowing are preferable to 3 days and just after sowing.

Pre-emergence treatments in some cases gave very good control of annual weeds, but were entirely ineffective in the control of perennials. Couch grass was prevalent and is partly responsible for the low yields. (Contribution of Experimental Farms Service, L'Assomption, Que., Can.)

11 Residual effect of pre-emergence treatments with 2,4-D on weeds in corn. Zalik, Saul and P. J. Olson. In an experiment to study the effect of residual 2,4-D on corn, 16 ounces pure acid per acre of butyl ester and sodium salt formulations were applied on May 17. About 4 days later a dense mat of red-root pigweed emerged on all the treated and check plots. On June 10 the treated and untreated check plots were thoroughly cultivated. Following this cultivation, a new crop of pigweed emerged on the check plots, but for practical purposes the treated plots remained weed-free. There was no difference between formulations. None of the treatments had any adverse effect on the corn. (Contribution of the Div. of Plant Sci., Univ. of Manitoba, Winnipeg, Can.)

12 The effect of 2,4-D on hybrid corn strains yields. McKibben, G. E. and R. F. Fuelleman. A regular series of some 60 corn strains planted in a corn performance test at the Dixon Springs Station was used for this test. Amine, ester, and sodium salt compounds with and without cultivation were compared with cultivated and uncultivated checks. Good control of broadleaved species was obtained with all concentrations of 2,4-D. Normal cultivation was the basis for comparison; and when fields are badly infested with grass weed species, cultivation is still the most efficient tool of control. Cultivation plus 2,4-D in heavy concentrations gives good control of all weeds but causes some damage to corn. Lighter concentrations of 2,4-D, plus cultivation, while less efficient in controlling grass weeds, did not damage the corn. Since this field has not been harvested, being composed of late-maturing strains, the data cannot be included at this time. (Contribution of the Dept. of Agron., Ill. Agr. Exp. Sta.)

13 Use of 2,4-D and related materials for pre-emergence weed control in corn. Buchholtz, K. P. Corn plots 20 hills in size were planted with the yellow dent single hybrid R3 x M13 in a Miami silt loam of average fertility. Two days after planting, plots were sprayed with the sodium salt of 2,4-D at the rate of 1, 2 and 4 of the acid equivalent per acre. Additional plots were sprayed at the same time with the butyl ester of 2,4-D and the isopropyl esters of 2,4,5-T and MCP at the rate of 2 pounds per acre. All applications were replicated 4 times and the data were analyzed statistically. The season was exceptionally dry, and except for a 1/4-inch shower the surface soil remained dry for several weeks after planting. The corn emergence was not affected by any of the applications. Only partial weed control was obtained. Check plots averaged 7.1 broadleaved leaves per plot. Plots treated with the 1, 2 and 4 applications of the sodium salt and the butyl ester of 2,4-D and the isopropyl esters of 2,4,5-T and MCP averaged 1.9, 1.0, 0.6, 0.8, 2.7 and 0.8 broadleaved weeds per square foot respectively. All of these stands are significantly less than check. The same plots averaged 16.4, 8.6, 4.3, 9.2, 8.4 and 5.9 grassy weeds per square foot, while checks averaged 20.2 grassy weeds per square foot. All of these stands are significantly less than check except the 1 pound of sodium salt application. All treated plots had considerable weed growth on them that was allowed to remain during the remainder of the season. Grain yields of 20.7, 36.1, 40.1, 39.8, 30.0, and 33.4 bushels per acre respectively were obtained. All of these are significantly lower than the clean-cultivated check yield of 60.8 bushels per acre. This reduction in grain yield was due to weed competition, since plots given pre-emergence treatments but kept clean-cultivated approximated the check in yield. (Contribution of the Dept. of Agron., Wis. Agr. Exp. Sta.)

14 Pre-emergence and post-emergence treatments of sweet corn with 2,4-D. Hernandez, T. P. One, two and four pounds of 2,4-D acid equivalent per acre were applied as pre-emergence treatments on May 25 immediately after Golden Cross Bantam sweet corn was planted on Miami silt loam soil. A sodium salt of 2,4-D acid was used. No rain occurred between the time that the pre-emergence treatments were applied and the time that the corn emerged. Post-emergence treatments using 0.5 and 1 pound of 2,4-D per acre were applied 24 days after the corn was planted, when it was approximately 6 inches tall. Also, 0.25, 0.5 and 1 pound of 2,4-D acid equivalent per acre were applied 35 days after the corn was planted, when it was approximately 18 inches tall. Weeds were removed from all plots by cultivation and hoeing before they were large enough to compete with the sweet corn. The broadleaved weeds present were pigweed (Amaranthus retroflexus), lamb's quarter (Chenopodium album), and purslane (Portulaca oleracea). The grasses were foxtail (Setaria spp.) and witchgrass (Panicum capillari). There was a reduction in the number of broadleaved weeds of 83 to 89 percent from the pre-emergence treatments. The post-emergence treatments applied 24 days after planting gave a reduction of approximately 74 percent in the number of broadleaved weeds; those applied 34 days after planting, a reduction of 56 to 74 percent. The pre-emergence treatments gave a reduction in the number of grasses of 75 to 86 percent; the post-emergence treatments, however, gave little or no reduction in the number of grasses. No significant reduction in yield of sweet corn resulted from any of the 2,4-D treatments. (Contribution of the Dept. of Hort., Wis. Agr. Exp. Sta.)

15 Effect of pre-emergence treatments with 2,4-dichlorophenoxyacetic acid on corn. Zahnley, J. W. and G. L. McCall. Treatments with isopropyl ester, triethanol amine, and monohydrate sodium salt at rates of 3/8, 3/4 and 1 1/2 pounds of acid per acre were applied on May 15, 1948, four days after planting Pride of Saline, an open-pollinated variety of corn. The soil was in good tilth, and moisture conditions were favorable for prompt germination of both the corn and the weeds. A total of 64 plots were thus treated on four blocks, with the plots duplicated in each block, making eight replications of each formulation and rate. Both untreated and cultivated checks were likewise replicated. Rainfall following treatment was moderate and favorable for effectiveness of the chemical. At harvest time the number of hills, number of stalks, number of ears, and yield were determined. Time has not permitted completion of statistical analysis of the data, but the following results are apparent: There was little if any difference in the effectiveness of the different formulations. All pre-emergence treatments gave better weed control than post-emergence treatments made in the same field. There was no apparent injury to the corn by any of the formulations or rates. The higher rates gave larger yields and better control of weeds. The cultivated checks produced highest yields of all plots and the untreated checks not cultivated were lowest. (Contribution of the Dept. of Agron., Kan. Agr. Exp. Sta.)

16 Results of pre-emergence treatment of corn with 2,4-D materials at Urbana, Illinois, 1948. Fuelleman, R. F. and F. W. Slife. A series of replicated plots of hybrid corn, Illinois 972, were used for pre-emergence treatment on the day of planting and three days after planting. Untreated, uncultivated, and cultivated check plots were used for comparison. The field used was fertile and relatively free from weeds. Dry, warm weather prevailed for two weeks preceding treatment and continued for a week following treatment. The appended table gives the pertinent data. Where three days elapsed between planting and treatment, which consisted of 0.3 pound of ester and amine and 0.5 pound of sodium salt, a slightly lowered yield was obtained; however, analysis indicates that this difference was not significant. The number of weeds per square foot varied, but the results indicate that the degree of control by pre-emergence treatments during dry, warm weather was much better than that obtained by a single cultivation. Yield results were calculated on the basis of 15.5 percent moisture. (Contribution of Dept. of Agron., Ill. Agr. Exp. Sta.)

PROJECT IV. PRE-EMERGENCE TREATMENTS WITH 2,4-D AND OTHER HERBICIDES TO CONTROL WEEDS IN FIELD CROPS OTHER THAN CORN.

Summary

Investigation leader - K. P. Buchholtz

Observations were received on the use of chemicals for pre-emergence weed control in spring wheat, spring oats, spring barley, spring rye, winter wheat, sorghum, flax, soybeans, bromegrass, sweet clover, sunflowers, sugar beets, alfalfa and peas.

Weed control was variable but was poor in general. Little weed control was ever obtained when the chemicals were applied to dry or nearly dry soil and rain was not received for several weeks. The application of chemicals to damp soil usually gave at least fair weed control. In cases where considerable amounts of rain occurred within a week or two of application the weed control was often good. Under favorable conditions weed control was obtained with 1 pound of 2,4-D as the acid equivalent. Under dry conditions 4 lbs. of 2,4-D were ineffective. In cases where partial weed control was obtained redroot pigweed, Russian thistle and wild buckwheat appeared to be more resistant to 2,4-D than other broad leaved species. Annual grassy weeds showed a still greater degree of resistance. In cases where comparisons were made there was little consistency in degree of weed control obtained with different 2,4-D preparations. The ammonium salt of dinitro-o-sec-butylphenol applied at rates as high as 2 pounds per acre failed in any case to reduce weed growth. Dinitro-o-sec-butylphenol applied at rates up to 4 pounds per acre was likewise ineffective. TCA at rates as low as 6 pounds per acre gave satisfactory control of foxtail. It was evident that soil moisture at the time of application and precipitation during the next few weeks were factors that determined to a marked degree the results obtained. The data suggest that soil type may also play a part in determining the results obtained.

The relative resistance of the different crops tested to the various chemicals cannot be stated accurately since in no case were all crops included in one test. Sweet clover, alfalfa and bromegrass were reported to be especially sensitive to 2,4-D followed by sugar beets and sunflowers. Of the five cereals observed, oats appeared to be the most sensitive and barley the most resistant with winter wheat, spring wheat and spring rye being intermediate. Flax, soybeans and sorghum are probably somewhat less resistant than the five cereals mentioned.

The injury noted most frequently following chemical applications was reduced crop stands. Growth of the emerged plants was often depressed. Yields were occasionally reduced but partial recovery often compensated for initial reductions in stand or growth depression of seedlings. Application a day or two prior to emergence rather than at seeding time of the crop plant resulted in distinctly less injury to the crop plant in several instances. Applications made as the crop was emerging, however, usually caused head, root and leaf abnormalities.

Application of 2,4-D at rates as low as 1 pound per acre at times gave significant injury to stand. The response of crops to the different preparations of 2,4-D were not entirely consistent, but an acid preparation of 2,4-D caused less injury to 5 crops in one extensive test. The ester and amine preparations of 2,4-D caused comparable injury in general. In one experiment the ester of 2,4,5-T caused somewhat greater reductions in stand than any of

the 2,4-D preparations. Flax was shown to be affected somewhat by applications as low as 6 pounds of TCA and 2 pounds of IPC. In no instance were any effects on crop yields of any crop noted following applications of up to 2 pounds of the ammonium salt of dinitro-o-sec-butylphenol or up to 4 pounds of dinitro-o-sec-anylphenol.

It was evident from the data that crop response to the various applications was greatly influenced by soil conditions at the time of application and the rainfall shortly thereafter. Heavy rainfall in the week following planting is probably the most important factor in increasing injury. A moist soil at planting time also tends to increase injury. Both of these conditions are beneficial in that they aid weed kill, however. Some of the data suggest that deeper planting of the small grains may reduce injury to stand somewhat.

PROJECT IV PRE-EMERGENCE TREATMENTS WITH 2,4-D AND OTHER HERBICIDES TO CONTROL WEEDS IN FIELD CROPS OTHER THAN CORN

Abstracts of Results of Individual Cooperators.

Spring Wheat

17 Pre-emergence treatments with 2,4-D to control weeds in spring planted wheat. Friesen, H. A. Three formulations of 2,4-D were applied to plots sown to spring wheat, the dosages used were, viz: 0.5, 1, 2 and 4 pounds acid per acre. The treatments were made at four dates, viz; (1) immediately after planting, (2) 2 days after planting, (3) 4 days after planting, and (4) 6 days after planting.

Due to the dry hot seasonal conditions, which prevailed in 1948, weed growth was not in evidence until some two weeks after the treatments were made. After this time Russian thistle Salsola kali emerged abundantly on both the treated and the untreated plots. On the basis of weed counts taken four weeks after spraying none of the treatments appeared to be effective in reducing the Russian thistle population. Yield differences of a significant magnitude were not found to exist between the treated and the untreated plots. (Contributed by the Dominion Experimental Station, Scott, Sask.).

18 Pre-emergence treatment with 2,4-D to control weeds in wheat. Carder, A. C. Four rates, viz., 8, 16, 32, and 64 ounces acid equivalent per acre of the butyl ester of 2,4-D were applied immediately after and 2, 4, and 6 days after seeding Thatcher wheat. The wheat had emerged by the time the last treatment was made. Very dry surface soil conditions discouraged weed seed germination, while the wheat produced a partial stand. A study of the sparse weed growth suggested effective control of stinkweed (Thlaspi arvense), ball mustard (Neslia paniculata), and flixweed (Sisymbrium Sophia) by the 8-ounce or heavier rates applied at each of the 4 dates. The maturity of the wheat was not delayed by any treatment. The 64-ounce rate caused some deformation of head regardless of the time it was applied. Heavy rains a full month after seeding induced a full germination of weeds along with a late germination of wheat. Stands of late-germinated grain were considerably reduced by all rates and dates of 2,4-D treatment with the heavier applications indicating much the greater residual effect of the chemical. The second germination of weeds was likewise markedly curtailed by the 2,4-D application. Reduction ranged from 50 to 80 per cent depending on the rate of application. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

19 Pre-emergence treatment of spring wheat with 2,4-D and Sinox-W in 1948 at Howard, So. Dakota. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. Rival wheat was seeded approx. 2 inches deep on April 10. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on April 18 at the following rates of acid equiv. per acre: 0, 0.25, 0.5, 1, 1.5 and 2 lbs. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.5, 1, and 2 gal. Three replications were made of each treatment. At time of treatment soil moisture was good, sky clear, wind 3 mph, temp. 82°. April precipitation after treatment totaled 2.26 in., May 3.64 in., June 5.18 in. Four weeks after crop emergence control of both narrow and broad leaved annuals was good at rates of 1 lb. or

more per acre. Crop stand was reduced at 1.5 and 2 lb. rates. Sinox-W showed little or no weed control and no crop damage. At harvest time weed counts were approx. equal in all plots. There were no significant differences in final yields at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

20 Pre-emergence treatment of spring wheat with 2,4-D and Sinox-W in 1948 at Orient, So. Dakota. MacDonald, W. P., Slough, A. T. and Zinter, Clinton. Rival wheat was seeded on a sandy loam soil at a depth of approx. 2.5 in. on April 22. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on April 24 at the following rates of acid equiv. per acre: 0, 0.25, 0.5, 1, 1.5 and 2 lb. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.5, 1, and 2 gal. Three replications were made of each treatment. At the time of treatment soil moisture was good, sky clear, wind absent, temp. 72°, humidity 56%. April precipitation following treatment was 0.50 in.; May 0.54 in.; June 6.86 in. One month after treatment there was some evidence of control of broad and narrow leaved annuals at the 2 lb. rate, also some stunting of the wheat. At harvest time weed counts were approx. equal in all plots. Final yield data indicated a very significant yield increase for the 1.5 lb. rate at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

21 Pre-emergence treatment of spring wheat with 2,4-D and Sinox-W in 1948 at Zap, No. Dakota. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. Thatcher wheat was seeded at a depth of approx. 3 in. on April 23 and April 26 on a sandy loam soil. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on April 27 at the following rates of acid equiv. per acre: 0, 0.25, 0.5, 1, 1.5 and 2 lbs. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.5, 1, and 2 gal. Three replications were made of each treatment. At time of treatment soil moisture was good, sky clear, no wind, temp. 72°, humidity 61%. There was no precipitation in April after treatment; May 1.50 in.; June 5.60 in. One month after emergence control of susceptible broad-leaved annuals was good at 2,4-D rates of 1 lb. or more per acre. Some reduction in stand of annual grasses. Wheat growth stunted at 2 lb. rate. Sinox-W showed no weed control or crop damage. At harvest time weed counts were approx. equal in all plots. There were no significant differences in final yields at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

22 Pre-emergence treatment of spring wheat with 2,4-D and Sinox-W and Sinox General in 1948 at Kragnes, Minn. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. Mida wheat was seeded on a Fargo-Bearden soil at a depth of approx. 2 in. on May 10. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on May 13 at the following rates of acid equiv. per acre: 0, 0.5 and 1 lb. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.5, and 1 gal. Sinox General was applied with 5 gal. of water and fuel oil at the following rates: 0, 1, 2, and 4 qt. Three replications were made of each treatment. At the time of treatment soil moisture was fair, sky clear, wind 7 mph, temp. 63°, humidity 32%. At no time during the season was there evidence of weed control or crop injury. At harvest time weed counts were approx. equal in all plots. There were no significant differences in final yields at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

23 Response of spring wheat to pre-emergence treatments with systemic (hormone) chemicals. Pavlychenko, Thomas K. The season of 1948 at Saskatoon, Sask. was dry and hot. To secure germination the land was irrigated (once) with 3 inch. of water. Four series of triplicate, spaced row plots on the Saskatoon sandy loam were treated at temperatures of 80 and 85°F with: Weedone concentrate 48 and Weedone #5 (ethyl esters, 2,4-D), LFN549 (ester 2,4,5-T), Weedar 64 (amine, 2,4-D), LFN472 (2,4-D acid), 95% monohydrate sodium salt (2,4-D), and Weed-No-More (butyl ester, 2,4-D). Three controls were provided in each series. Series 1 and 2 were treated, one day after seeding, and series 3 and 4, one day prior to emergence, with 1 and 2 lbs./a. rates respectively. Results: The emergence was significantly reduced in series 1 and still further in series 2 by all chemicals. In both series LFN472 allowed the highest emergence (77 and 72%); Weedone concentrate 48 (71 and 64); Weed-No-More (68 and 62); Weedone #5 (68 and 59); Weedar 64 (64 and 61), and the sodium salt (63 and 58). In series 3 and 4 the emergence was considerably higher in all cases. The corresponding figures for LFN472 were: 89 and 83%; Weed-No-More, 82 and 78; Weedone concentrate 48, 82 and 77; LFN549, 81 and 73; sodium salt 76 and 76; Weedar 64, 72 and 74, and Weedone #5, 72 and 68%. The mortality of seedling after emergence was very low (1 to 5%). Slight depression was observed in series 1 and 3. In series 2 and 4 only first stalks grew normally, the young tillers were seriously stunted and many did not mature. Excellent control of weeds was secured in series 1 and 2, but the depressed redroot pigweed and wild buckwheat survived in series 3 and 4. The sodium salt seemed to be equally or more severe in the pre-emergence treatments than either esters or amine salt. (Contribution of Agr. Field Res., Amer. Chem. Paint Co., Ambler, Pa.).

Spring Oats

24 Effect of pre-emergence 2,4-D on yields of Clinton oats at Columbus, Ohio. Shaw, Warren C. and C. J. Willard. Clinton oats sown April 14 were treated April 17 with the triethanol amine salt, the sodium salt, and the butyl ester of 2,4-D at 0.5, 1, 1.5, 2 and 4 pounds acid equivalent per acre. The test was a randomized block design, with 3 replications. The plots were 10' x 40'. Weeds were only a minor factor in the yields, but were controlled by the treatments of all materials at rates down to 1.5 pounds per acre. The yields of the treated plots averaged considerably, but probably not significantly, above the check plots. Only 3 of the 15 treatments indicated reductions in yield, of 2.0 bu., 1.2 bu., and 0.1 bu., respectively - entirely non-significant. (Contribution from Ohio Agr. Exp. Station).

25 Pre-emergence treatment of oats with 2,4-D and Sinox-W in 1948 at Howard, So. Dakota. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. Clinton oats were seeded on a good loam soil on April 14 at a depth of approx. 1.5 in. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on April 18 at the following rates of acid equiv. per acre: 0, 0.25, 0.5, 1, 1.5, and 2 lb. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.5, 1, and 2 gal. Three replications were made of each treatment. Soil moisture at the time of spraying was good. The sky was cloudy, wind 12 to 15 mph, temp. 65°. April precipitation after treatment totaled 2.26 in.; May 3.64 in.; June 5.18 in. One month after emergence control of both narrow and broad leaved annuals looked good where the application was 1 lb. or more per acre. Stand of oats appeared to be

adversely affected at the 1.5 and 2 lb. rates. Sinox-W showed little or no weed control and no crop damage. At harvest time weed counts were approx. equal in all plots. There were no significant differences in final yields at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

26 Pre-emergence treatment of oats with 2,4-D and Sinox-W in 1948 at Orient, So. Dakota. MacDonald, W. P., Slough, A. T. and Zinter, Clinton. Vicland oats were seeded at a depth of approx. 2 in. in a good local soil on Appil 22. Amine formulation of 2,4-D and Sinox-W were applied as a spray with 5 gal. of water on April 24 at the following rates: 2,4-D - 0, 0.25, 0.5, 1, 1.5, and 2 lb. Sinox-W - 0 and 1 gal. At the time of treatment soil moisture was good, light rain was falling, wind 5 mph, temperature 60°, humidity 59%. Precipitation in April following treatment totaled 0.50 in; May 0.54 and June 6.86 in. One month after emergence there was some evidence of annual weed control at the 1.5 and 2 lb. rates. No crop damage. Sinox-W showed no weed control or crop damage during the season. At harvest time weed counts were approx. equal in all plots. There were no significant differences in yields at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

27 Pre-emergence treatment of oats with 2,4-D and Sinox-W in 1948 at Merrifield, No. Dakota. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. Vicland oats were seeded at a depth of approx. 2.5 in. on May 11 on heavy clay soil. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on May 17 at the following rates of acid equiv. per acre: 0, 0.25, 0.5, 1, 1.5 and 2 lbs. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.5, 1, and 2 gal. Three replications were made of each treatment. At time of treatment soil moisture was good, sky clear, wind absent, temp. 74°, humidity 35%. No precipitation in May after treatment; June 4.38 in.; July 5.02 in. No appreciable weed control was noticeable during the season and there was no apparent crop injury. Neither were there significant differences in the final yields at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

28 Pre-emergence treatment of oats with 2,4-D and Sinox-W in 1948 at Beulah, No. Dakota. MacDonald, W. P., Slough, A. T. and Zinter, Clinton. Vicland oats were seeded at a depth of approx. 2.5 in. on a sandy loam soil on April 29. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on May 5 at the following rates of acid equiv. per acre: 0, 0.25, 0.5, 1, 1.5, and 2 lbs. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.5, 1, and 2 gal. Three replications were made of each treatment. At time of treatment soil moisture was fair, sky clear, wind 3 mph, temp. 62°, humidity 69%. May precipitation after treatment was 0.35 in.; June 2.40 in.; July 2.63 in. One month after emergence control of mustard and sunflowers was good with applications of 1.5 and 2 lbs. Oat stands were slightly reduced at 2 lbs. Sinox-W showed no weed control and no crop damage. At harvest time weed counts were approx. equal in all plots. There were no significant differences in final yields at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

29 Response of spring oats to pre-emergence treatments with systemic (hormone) chemicals. Pavlychenko, Thomas K: The season of 1948 at Saskatoon, Sask. was dry and hot. To secure germination the land was irrigated (once) with 3 inch. of water. Four series of triplicate, spaced

row plots on the Saskatoon sandy loam were treated at temperatures of 80 to 85°F with: Weedone concentrate 48 and Weedone #5 (ethyl esters, 2,4-D), LFN549(ester, 2,4,5-T), Weedar 64 (amine, 2,4-D), LFN472 (2,4-D acid), 95% monohydrate sodium salt of 2,4-D and Weed-No-More (butyl ester, 2,4-D). Three controls were provided in each series. Series 1 and 2 were treated, one day after seeding, and series 3 and 4, one day prior to emergence, with 1 and 2 lbs./acre rates respectively. Results: oats reacted more strongly to all the chemicals used than any of the four cereals tested. In series 1, 16 to 53 pct. of the sprouts and 2 to 7 pct. of the young seedlings died before or soon after emergence. The surviving plants were seriously depressed in all but LFN472, plots with younger tillers often failing to mature. All these damages were intensified in series 2, with the mortality of sprouts and seedling from 24 to 57 pct., and the reduction in height of the surviving plants from 5 to 7 inches. No morphological disturbances were observed in these tests in 1948. In series 3, the mortality of sprouts and seedlings was much lower, 12 to 26 and 1 to 5 pct. respectively. The crop was only slightly depressed and the younger tillers less retarded. Identical conditions existed in series 4 with only slightly higher mortality of the sprouts and seedling and more pronounced stunting. Weed control in series 1 and 2 was excellent with only few wild buckwheat plants surviving. Weed control in series 3 and 4 was less effective. (Contribution of Agr. Field Res., Amer. Chem. Paint Co., Ambler, Pa.)

Spring Barley

30 Pre-emergence treatment of barley with 2,4-D and Sinox-W in 1948 at Beulah, No. Dakota. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. O. A. C. 21 barley was seeded at a depth of approx. 2.5 in. on a light loam soil on April 29. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on May 4, at the following rates of acid equiv. per acre: 0, 0.25, 0.5, 1, 1.5, and 2 lbs. Two gal. of Sinox were also applied with 3 gal. of water per acre. Three replications were made of each treatment. At time of treatment soil moisture was good, sky clear, wind 4 mph, temp. 56°, humidity 60%. May precipitation following treatment was 0.45 in., June 2.40 in., July 2.63 in. One month after emergence there was no evident control of any weed species. Barley appeared stunted on the 2 lb. plots. Sinox-W showed no weed control and no crop injury. At harvest time weed counts were equal in all plots. There were no significant differences in final yield at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

31 Pre-emergence treatment of barley with 2,4-D and Sinox-W in 1948 at Howard, So. Dakota. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. Kindred barley was seeded on a good soil on April 19. Seeding depth approx. 2.5 inches. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on April 20 at the following rates of acid equiv. per acre: 0, 0.25, 0.5, 1, 1.5 and 2 lbs. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.25, 1, and 2 gal. Three replications were made of each treatment. At time of treatment soil moisture was good, sky clear, wind 4 mph, temp. 68°. April precipitation after treatment totaled 2.26 in.; May 3.64 in.; June 5.18 in. Three weeks after crop emergence control of narrow and broad leaved annuals was good where the application was 1 lb. or more per acre. Stand of barley was reduced at 1.5 and 2 lb. rates. Sinox-W showed little or no weed control and no crop damage. At harvest time the weed counts were approx. equal in all plots. Harvest tests showed a sig-

nificant yield increase from the 1 lb. 2,4-D treatment and a very significant yield increase from the 1.5 lb. 2,4-D treatment at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

32 Pre-emergence treatment of barley with 2,4-D and Sinox-W in 1948 at Orient, So. Dakota. MacDonald, W. P., Slough, A.T., and Zinter, Clinton. Kindred barley was seeded at a depth of approx. 1.5 in., on a good local soil on April 23. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on April 24 at the following rates: 0, 0.25, 0.5, 1, 1.5 and 2 lb. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.5, 1, and 2 gal. Three replications were made of each treatment. At the time of treatment soil moisture was good, sky cloudy, wind 5 mph, temp. 68°, humidity 57%. Following treatment April precipitation was 0.50 in.; May 0.54 in.; June 6.86 in. There was no evidence of weed control or crop injury during the season. Final yields showed no significant differences at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

33 Pre-emergence treatment of barley with 2,4-D and Sinox-W in 1948 at Kragnes, Minn. MacDonald, W. P., Slough, A. T. and Zinter, Clinton. Kindred barley was seeded on Fargo-Bearden loam at a depth of approx. 2 in. on May 12. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on the same date at the following rates of acid equiv. per acre: 0, 0.25, 0.5, 1, 1.5, and 2 lb. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.5, 1, and 2 gal. Three replications were made of each treatment. At the time of treatment soil moisture was fair, sky clear, wind absent, temp. 72°, humidity 18%. No weed control or crop injury was noticeable during the season. At harvest time weed counts were practically the same in all plots. Final yields were significantly lower for the 1 lb. and 1.5 lb. applications, calculated at the 5% level. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

34 Response of spring barley to pre-emergence treatments with systemic (hormone) chemicals. Pavlychenko, Thomas K. The season of 1948 at Saskatoon, Sask. was dry and hot. To secure germination the land was irrigated (once) with 3 in. of water. Four series of triplicate, spaced row plots on the Saskatoon sandy loam were treated at temperatures of 80 to 85°F with: Weedone concentrate 48 and Weedone #5 (ethyl esters, 2,4-D), LFN549 (ester, 2,4,5-T), Weedar 64 (amine, 2,4-D), LFN472 (2,4-D acid), 95% monohydrate sodium salt of 2,4-D and Weed-No-More (butyl ester, 2,4-D). Three controls were provided in each series. Series 1 and 2 were treated, one day after seeding, and series 3 and 4, one day prior to emergence, with 1 and 2 lbs./a. rates respectively. Results: of all the cereals tested in the pre-emergence project, barley emerged in higher percentages at the two rates and dates of all the chemicals tested. On the other hand, it suffered considerable depression, seedling mortality and reduction in tillering at both rates, series 1 and 2, but was reasonably free of these injuries in series 4 and particularly in series 3. LFN 549 and butyl ester were most severe on young seedlings in series 1 and 2 and caused high seedling mortality (4 to 8%) and very conspicuous depression of the crop at maturity. Weedone #5 was less damaging while other chemicals were quite tolerant. Weed control was excellent in series 1 and 2 and very satisfactory including wild buckwheat in series 3 and 4. This outstanding weed control, however, seemed to be acheived only partially by the chemicals. The competitive ability of barley apparently has also materially contributed to the final results. (Contribution of Agr. Field Res., Amer. Chem. Paint Co., Ambler, Pa.)

Spring Rye

35 Response of spring rye to pre-emergence treatments with systemic (hormone) chemicals. Pavlychenko, Thomas K. The season of 1948 at Saskatoon, Sask. was dry and hot. To secure germination the land was irrigated (once) with 3 inch. of water. Four series of triplicate, spaced row plots on the Saskatoon sandy loam were treated at temperatures of 80 to 85°F with: Weedone concentrate 48 and Weedone #5 (ethyl esters, 2,4-D), LFN549 (ester, 2,4,5-T), Weedar 64 (amine 2,4-D), LFN472 (2,4-D acid), 95% monohydrate sodium salt of 2,4-D and Weed-No-More (butyl ester, 2,4-D). Three controls were provided in each series. Series 1 and 2 were treated, one day after seeding, and series 3 and 4, one day prior to emergence; with 1 and 2 lbs./a. rates respectively. Results: at both 1 and 2 lbs./a. rates applied immediately after seeding the emergence was decidedly reduced, in the plots of LFN472 to 69 and 57%; Weed-No-More 60 and 53; Weedone concentrate 48, 59 and 52; Sodium salt 58 and 45; Weedar 64, 58 and 51; LFN549, 54 and 49% and Weedone #5, 54 and 46%. Seedling mortality reduction in tillering and depression of crop were relatively low in series 1, but nearly twice as high in series 2. All annual weeds excepting wild buckwheat were effectively controlled. In series 3 the emergence was much higher, 64% being the lowest in Weedone #5 and 71%, the highest in LFN472. In series 4 it was only slightly lower. The seedling mortality was apparent in series 3 and 4, also, but lower than in series 1 and 2. Depression of crop was not observed in series 3 but was conspicuous in series 4. Weed control in series 3 and 4 was less satisfactory than in series 1 and 2. (Contribution of Agr. Field Res., Amer. Chem. Paint Co., Ambler, Pa.)

Winter wheat

36 Effect of pre-emergence 2,4-D on winter wheat, Columbus, Ohio. Willard, C. J. and Warren C. Shaw. Thorne wheat was treated October 6, 1947, immediately after sowing, with the triethanol amine salt, the sodium salt, and the butyl ester of 2,4-D at 0.5, 1, and 2 pounds per acre acid equivalent in duplicated randomized plots. The average yield of the 18 treated plots was 49.6 bu. per acre, of 26 untreated checks 47.2 bu. Weeds were not a factor in the yields. The treated plots were darker green early in the spring of 1948, but later were indistinguishable from the checks. The two pound rates were not lower in yield than the others, but all were highly variable. (Contribution from the Ohio Agr. Exp. Station).

Grain Sorghum

37 Pre-emergence treatments of grain sorghum with 2,4-D. Elder, W. C. Standard Blackhull kafir C.I. No. 71 was planted one inch deep in a moist sandy loam soil on May 15, 1948. Immediately after planting, 0.5, 1 and 2 pounds of ester of 2,4-D per acre were applied in water at rate of 40 gallons per acre. All plots were cultivated and weeds removed with the hoe. Grain yields were taken from 2 middle rows of the 4 row plot. The 0.5 and 1 pound rates of 2,4-D did not affect the yields of grain. The 2 pound rate cut yie yields in half. The loss was due principally to poor stands. Many of the young plants were killed before coming up or when small. (Okla. Agri. Exp. Sta.)

Flax

38 Effects of 2,4-D, TCA, IPC and Contact dinitro on the yields and test weight of flax when applied as pre-emergence sprays. Derscheid, Lyle A., L. M. Stahler, and D. E. Kratochvil. Randomized plots of Dakota flax 1 rod long and 7 feet wide were treated in triplicate at seeding time and 3 days later (1 day before flax emerged) with 1, 2 and 4 pounds of 2,4-D acid per acre, in triethanol amine form; 6, 12, and 24 pounds of TCA acid per acre, in ammonium salt form, 2, 4 and 8 pounds of IPC per acre and 1, 2, and 4 pounds of dinotro-O-sec-amylphenol per acre. Applications at seeding time were made in the forenoon and three tenths of an inch of rain fell that night. Stands of flax, on plots treated at seeding time, were reduced 50, 30 and 20 per cent by 4, 2 and 1 pounds of 2,4-D; 40, 25 and 15 per cent by 24, 12 and 6 pounds of TCA and 30, 20 and 10 per cent by 8, 4 and 2 pounds of IPC, respectively. These thin stands were not noticeable at harvest. An analysis of variance indicates that test weight of the flax was not affected by these treatments and that significant changes in yield due to treatment with 2,4-D, IPC or dinitro were not established. All rates of TCA applied at seeding time reduced the yield of flax significantly; whereas, only the two higher rates reduced yields when applied just prior to emergence. Foxtails (Setaria spp.) were satisfactorily controlled by TCA while common ragweed (Ambrosia artemisifolia) and Kochia (Kochia scoparia) were controlled by all rates of 2,4-D applied on the later date. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. D. A.)

39 Pre-emergence treatment of flax with 2,4-D and Sinox-W in 1948 at Beulah, No. Dakota. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. B-Golden and B-5128 flax were seeded at a depth of approx. 0.5 in. on a sandy loam soil on May 4. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on April 5 at the following rates of acid equiv. per acre: 0, 0.5, 1, 1.5, and 2 lbs. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.5, 1 and 2 gals. Three replications were made of each treatment. At time of spraying soil moisture was fair, sky clear, wind 3 mph, temp. 58°, humidity 46%. No rain fell in May after treatment; June precipitation 2.40 in.; July 2.63 in. At no time during the season was there damage to either flax variety. At harvest time weed counts were approx. equal in all plots and checks. There were no significant differences in final yields at the 5% level. (Contribution of the Agr. Dept., F. H. Peavey and Co., Minneapolis).

40 Pre-emergence treatment of flax with 2,4-D and Sinox-W in 1948 at Howard, So. Dakota. MacDonald, W. P., Slough, A.T., and Zinter, Clinton. Koto flax was seeded on a good soil on April 16 at a depth of approx. 1 in. Amine formulation of 2,4-D was applied as a spray with 5 gal. of water on April 20 at the following rates of acid equiv. per acre: 0, 0.25, 0.5, 1, 1.5, 2 lbs. Sinox-W was applied with 5 gal. of water at the following rates: 0, 0.25; 0.5 and 1 gal. Three replications were made of each treatment. At time of treatment soil moisture was good, wind 6 mph, temp. 65°. April precipitation after treatment totaled 2.26 in.; May 3.64 in.; June 5.18 in. One month after emergence weed control looked good on all annual species at rates of 1 lb. or more. Flax stands on the 1.5 and 2 lb. plots appeared badly damaged. Sinox-W showed no weed control and no crop injury. At harvest time weed counts were aporox. equal in all plots. There were no

significant differences in final yields at the 5% level. The 2 lb. plots actually outyielded the others and all evidence of flax injury at this rate had disappeared. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

41 Response of Royal flax to pre-emergence treatments with systemic (hormone) chemicals. Pavlychenko, Thomas K. Seven chemicals, each at 1 and 2 lbs./a. rates were used: Weedone concentrate 48 and Weedone #5 (ethyl esters, 2,4-D), LFN549 (ester, 2,4,5-T), Weedar 64 (amine salt, 2,4-D), LFN472 (2,4-D acid), 95% monohydrate sodium salt of 2,4-D, and Weed-No-More (butyl ester, 2,4-D). Four series of triplicate, spaced row plots were treated on the Saskatoon sandy loam soil, with abundant moisture (irrigated once) and temperatures of 80 to 85°F. Series one was treated with 1 lb./a. and series two with 2 lbs/a. rates, one day after seeding; series 3 with 1 lb./a. and series 4 with 2 lbs./a., one day prior to emergence. Results: in series 1 and 2 germination was mostly below 30%, the highest in the esters and amine salt plots being 25%, sodium salt 28%, and in 2,4-D acid alone 49%. There was an economically significant mortality of the emerged plants, this being in the ester and amine salt 7 to 32% and in the sodium salt and 2,4-D acid plots 3 to 6%. The surviving plants in the ester and amine salt plots were somewhat slower in growth and at maturity the stunting was 2 to 6 inches. In series 3 and 4 the germination was: 2,4-D acid (84%), Weedar 64 (76%), and Sodium salt (73%); Weedone concentrate 48 (69%), Weed-No-More (61%) and LFN549 (46 to 53%). The emergence was only slightly lower in the 2 lbs./a. than in 1 lb./a. rate. In both series the post-emergence mortality was low (2 to 5%) and the stunting at maturity slight. The highly susceptible weeds were effectively controlled, but redroot pigweed, Russian thistle and wild buckwheat were fairly healthy. (Contribution of Agr. Field Res., Amer. Chem. Paint Co., Ambler, Pa.)

Soybeans

42 Effect of pre-emergence 2,4-D on different varieties of soybeans. Shaw, Warren C., Lewis C. Seboe and C. J. Willard. Five varieties of soybeans, Lincoln, Hawkeye, Richland, Earlyana, and H-5, were planted at each of two depths, shallow and deep, on each of three dates, May 24, June 4, and June 14, in a randomized split plot experiment with three replications. They were treated on the date of planting with 0, 0.75, 1.5 and 3 pounds per acre (acid equivalent) of the butyl ester of 2,4-D. In a fourth set of three replications, sown June 28, the first replication was treated June 28, the second June 30 and the third July 3, when many cotyledons were visible. Careful independent evaluations by two observers gave the following conclusions: 1. The stand of beans was usually severely decreased. The stand was not reduced in the June 14 planting, when no rain fell between planting and emergence. In the June 28 planting, those treated June 28 were entirely killed, those treated July 3 had erfect stands at all rates of treatment. 2. The weed control varied from excellent to poor. When it was good or excellent, the beans were seriously injured. 3. Hawkeye was very conspicuously less injured than the other varieties. 4. The deep plantings were much less affected than the shallow plantings. (Contribution from the Ohio Agr. Exp. Station).

43 Pre-emergence spraying of soybeans with 2,4-D. Slife, F. W. and R. F. Fuelleman. Pre-emergence treatment at the rates of 0.75, 1.5 and 3 pounds acid per acre in the form of ester and sodium salt were used on

Richland soybeans. Applications at these rates were made immediately after planting and at three days after planting. Soybeans in all plots begin to emerge in five days. At the 3 pound rates there was some curvature and twisting of plants and the beans were depressed in height as compared to checks. At the light rates, there was very little apparent effect. Plant counts indicated that there was no reduction in stand due to treatment. At the heavy rates, weed control was good while at the lighter rates, weed control was poor. (Contribution of Ill. Agr. Exp. Sta.)

Miscellaneous Crops

44 Effect of pre-emergence application of 2,4-dichlorophenoxyacetic acid on wheat, barley and flax. Zalik, Saul, and P. J. Olson. The ester (butyl) and sodium salt formulations of 2,4-D were applied at rates of 8 and 24 ounces pure acid per acre to plots of Redman wheat, Montcalm barley and Royal flax. The applications were made on 3 dates: the day of seeding; six days after seeding; and 9 days after seeding. Severe reductions in stand resulted from the 24 oz. rate of both ester and sodium formulations applied at the first date. The 8 oz. rate of sodium caused some reduction in stand of barley and flax but not wheat. There was no visible effect on any of the crops from any treatment at the second date of application. All three crops had emerged by 9 days after seeding when the third date of application was made. At this date the 24 oz. rate of ester caused onion-like leaves in wheat and barley and severe burning of the young flax. The 8 oz. rate of ester and neither rate of sodium had any effect. There was no appreciable effect on the yield of wheat or flax from any formulation or rate at any date. In barley the 24 oz. rate of sodium salt at the first date of application resulted in a significant increase in yield. This increase in yield might be attributed in part at least to the increased straw strength of these plots resulting from the severe reduction in stand due to the application of 24 oz. sodium at the first date. (Contribution of Div. of Plt. Sc., The University of Manitoba, Winnipeg, Canada).

45 Effects of 2,4-D when applied as a pre-emergence spray on flax, bromegrass, sweetclover and oats. Hamilton, Roger D. and J.W. Zahnley. Isopropyl ester and monohydrate sodium salt of 2,4-D were used at rates of 0.5, 1, 2, and 4 lbs. per acre on the acid basis as pre-emergence treatments at two different dates of application. No difference in the date of planting could be observed since the ground was dry and no rain fell for nearly 3 weeks after planting. Due to the dryness of the ground the germination of flax was uneven in all plots. The flax that germinated early showed no effects of the 2,4-D, while that which germinated later, after the first rain, showed a yellowing of the seedlings, some of which died. Bromegrass and sweetclover were completely killed by all rates. The oats showed a stunted and an "onion top" condition in the heavier rates (2 lbs. of ester or more). Weeds were controlled 90% or more for a period of about 6 weeks with rates of 2 and 4 lbs. of the ester and 4 lbs. of the salt. Fewer seedlings of crabgrass and other weedy grasses were found in the treated plots. (Contribution of the Kansas Agricultural Experiment Station).

46 Pre-emergence treatments with 2,4-dichlorophenoxyacetic acid on crops of wheat, oats, barley and flax. Brown, D. A. This experiment was not conducted at Brandon, Manitoba, prior to 1948. All plots were 1/100 acre in size. Formulations used were ester, amine and sodium salt in concentrations ranging from 0.5 lb. acid per acre through 1, 2, to 4 lb. per

acre. Treatments were made by the use of an eight-foot boom wheel barrow spray rig on second, sixth and eighth days after the cereals and flax were seeded. Plots were randomized and ample checks were provided. Weed counts were made on all plots one month after spraying. Weeds present included Russian thistle (Salsola Kali L., var. tenuifolia G.F. W. Mey.), wild buckwheat (Polygonum Convolvulus), red root pigweed (Amaranthus retroflexus), lamb's quarter (Chenopodium album), stinkweed (Thlaspi arvense), night flowering catchfly (Silene antirrhina) common ragweed (Ambrosia artemisiifolia), perennial sow thistle (Sonchus arvensis). Weed counts of all these varieties varied so little between checks and treated plots including all formulations, concentrations, dates of application and classes of grain, that obviously no beneficial results were obtained by any of the treatments. Randomized samples were taken from all plots and yields of threshed grain obtained. Pre-emergence spraying left no influence on yields as no significant differences occurred over the entire set of plots. (Contributed by Division of Field Husbandry, Dominion Experimental Farm, Brandon, Man.).

47 Pre-emergence use of 2,4-D to control weeds in various crops. Wood, H.E., Bourns, J. J. Conflicting results followed trials at four widely scattered points, mostly on heavy clay soil, under adverse germinating conditions and competition from non-susceptible weeds (green foxtail and barnyard grass at two locations). Where ground was rather dry and no rain followed application of chemical to soil, little weed control was obtained, or much damage to crop. Where soil was moist or rain (0.5 to 1.5 inches) occurred soon after application, fair to good weed control obtained, even to reducing green foxtail. Effect on crop varied from none on corn, wheat, barley, and peas, to considerable on sunflowers, sugar beets, and marked on sweetclover and alfalfa. The ester at 4 oz. considerable; amine at both 12 and 24 oz. showed even more than ester. (Contribution of Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada).

48 The effect of 2,4-D when applied as pre-emergence spray on oats. Wolfe, Henry and Shafer, N. E. Square rod plots in adjoining plots of Clinton and Nemaha oats were sprayed with pre-emergence sprays. 2,4-D as the sodium salt and butyl ester was applied at 1/2, 1, 2 and 4 lbs. per acre on June 9, three days after planting. At emergence no difference could be noted in stand or appearance of the oat seedlings. Several weeks after emergence a darker green color was noticed on the plants sprayed with the 4 lb. applications, and to a lesser extent on the plots sprayed at rate of 2 lbs. per acre. Several days following the change in color, onion leafing and abnormal roots were apparent on the plants sprayed with 4 lbs. of 2,4-D. The roots were abnormally few and short and were covered with an excessive amount of root hairs. At heading time color differences were diminishing. Plants sprayed with 4 lbs. of 2,4-D were reduced in height. The onion leafing in most instances prevented the heads from emerging normally and in many cases heading did not occur. Many of the heads showed characteristic goose-necking which was the result of having to split the leaf sheath in order to appear. Many of the florets were sterile. With the exception of the 1/2 lb. treatments, yields were decreased in direct proportion to the amount of 2,4-D applied. The 1/2 lb. plot yields were equal to or greater than the check plot yields. No apparent difference as to varietal response was noted. (Dept. ofAgronomy, College of Agriculture, Lincoln, Nebraska).

PROJECT V. INVESTIGATIONS OF WEED CONTROL METHODS IN HORTICULTURAL AND TRUCK CROPS.

Summary

Investigation Leader: Buford H. Grigsby

In this section, a total of twenty-seven abstracts were submitted and distributed over the horticultural field as follows: vegetable crops 17, fruits 7, and miscellaneous 3, principally reports on the effects of herbicides on soils.

Asparagus. The reports dealing with this crop indicate that asparagus plants are injured by contact with 2,4-D sprays but are not usually killed by such contact. Pre-emergence usage of 2,4-D has not produced permanent injury to seedling asparagus. Alkyl ester and sodium salt formulations were used at dosages ranging from 0.25 to 3.0 pounds.

Beans. All reports on beans were from pre-emergence, residual, treatments and included 2,4-D, dinitros, chlorophenols, aromatic oils and TCA. The degree of weed control that can be obtained in the bean crops, appears to be more dependent upon the type of weed seeds present in the soil, than upon the chemical used.

2,4-D, at planting time, produced noticeable effects on bean foliage, but did not reduce stand nor yield. Reduction of both stand and yield occurred when the application was delayed until six days after seeding.

TCA, while it gave good control of annual grasses, had little effect upon broad leaved weeds and was toxic to beans.

Lima beans are more tolerant of chemicals than snap beans. Varietial differences in tolerance were found in snap beans.

Carrots. One abstract on selective weed control, and one on pre-emergence treatments in this crop, confirm the fact that most satisfactory control is obtained with petroleum products in the Stoddard solvent range. Other petroleum products may cause various types of injury and, when dinitros or chlorophenols are added, reduction in stand and yield usually follows. The high degree of selectivity of Stoddard solvent, in this crop and in coniferous seedlings, is unique in the field of weed control in horticultural crops.

Sweet Corn. Pre-emergence, residual, treatment with the sodium salt, alkyl ester and butyl ester formulations, gave satisfactory weed control without injury to corn. Weed control was obtained with dosages ranging from 0.5 to 2.0 pounds, acid equivalent, per acre. Smaller amounts were inadequate and, generally, a minimum effective dosage was one pound per acre.

Reports on post-emergence usage are very limited but indicate that, at equivalent dosages, ester formulations appear to give better weed control and greater injury to corn than the sodium salt. Maturity and yield of corn were not affected by any of the treatments reported.

Injurious effects, if any, are more closely related to soil type and soil moisture than they are to the type of 2,4-D formulation. Crop damage and weed control were more pronounced on sandy soil than on loam or peat.

Onions. Results obtained with this crop are reported in nine abstracts, of which seven are pre-emergence, residual, usage. There is considerable variation in the effects obtained with 2,4-D, but when used under very moist soil conditions, or when heavy rainfall followed applications, stands were generally reduced. Yield data, however, did not reflect the same degree of reduction, apparently because of the larger size attained by the surviving plants.

Post-emergence treatments were reported with a wide variety of materials but those of most importance were sulfuric acid, the dinitros, PCP (sodium salt), potassium cyanate, and salt. All were applied at a volume of 100 gallons per acre.

The results reported indicate that a number of herbicides can be used in the onion crop when the plants have two to three true leaves. 2.5 to 3.0 percent sulfuric acid gave better weed control as well as better yield of onions. Satisfactory results were reported with the various sodium salt formulations of PCP and potassium cyanate. The dinitros have generally reduced stands and yields. None of the materials have given satisfactory results when used on large weeds.

Strawberries. Reports from four locations indicate that fruiting plants of three varieties are tolerant of 2,4-D applications up to one pound, acid equivalent, per acre. Higher dosages caused severe distortion of leaves but did not kill the plants nor reduce the production of runner plants. No differences between amine salt, sodium salt and ester formulations were reported. Seedling plants, however, showed a great variation in tolerance. Control of annual weeds was satisfactory, in all cases, but one pound did not control perennial weeds.

TCA, at a rate as low as 10 pounds, acid equivalent, per acre caused severe injury to strawberry plants.

Other fruits. Two reports dealing with the use of TCA for the control of perennial grasses, chiefly quack grass, were received. 30 pounds, acid equivalent, per acre appeared to be the minimum quantity for control of quack grass and quantities in excess of this amount produced chlorosis in raspberry, blueberry, peach, and cherry. Fall and early spring applications caused less injury and were more effective as grass control measures.

A study of the results obtained by the various cooperators this season shows clearly that, with the exception of carrots, corn, and possibly onions, a great deal more research is needed before any conclusions can be drawn concerning herbicides for use in horticultural crops. Species which have large seeds generally respond better to pre-emergence, residual, treatments than small seeded species, but crop and variety variations are frequent in either group. It is apparent that 2,4-D, as a pre-emergence treatment, may have a much wider usefulness in this crop area than was thought possible a year ago, but experimentation under a wide variety of soil and climatic factors is still needed.

PROJECT V. INVESTIGATIONS OF WEED CONTROL METHODS IN HORTICULTURAL AND TRUCK CROPS.

Abstracts of Results of Individual Cooperators.

1 Chemical weed control in asparagus seed-beds. Alban, E. K., Leslie McCombs, and Homer Swingle. Pre-emergence applications of the alkyl ester of 2,4-D at the rate of 1.0 lb. acid equivalent, per acre, were applied two and thirteen days after planting the variety Mary Washington in a Miami silt loam. Post-emergence applications of 0.25 lb. of alkyl ester and 0.50 lb. of sodium salt of 2,4-D were made when the asparagus seedlings were one inch high and somewhat protected by the weeds which were two inches high. The pre-emergence treatment, thirteen days after planting, was very effective in controlling weeds for a period of seven weeks. There was no reduction in stand, or other visible damage noted with asparagus seedlings, following pre-emergence applications. The seedlings in the cultivated checks were only half the size of the treated seedlings after ten weeks. Post-emergence treatment, with the alkyl ester, caused foliage burn of asparagus seedlings but controlled broad leaved weeds so that cultivation was much easier than with untreated checks. The sodium salt post-emergence treatment, while not causing damage to seedlings, did not give satisfactory weed control. The damage to asparagus seedlings from post-emergence treatments was slight, as indicated by comparison with untreated seedlings three to four weeks after treatment. (Contribution of Dept. of Horticulture, Ohio Agricultural Experiment Station, Columbus, Ohio.)

2 The control of weeds in asparagus during the harvest and post-harvest season. Alban, E. K., Leslie McCombs, and Homer Swingle. During the 1948 season, 1.0, 2.0, and 3.0 lbs., acid equivalent, per acre of the alkyl ester and sodium salt of 2,4-D were applied at various times during the cutting and post-cutting period on a thirteen-year-old planting of Mary Washington asparagus. Retreatment of certain plots with 1.0 and 2.0 pounds of the alkyl ester of 2,4-D, or aromatic oil (15%) at 50 gallons per acre, alone, or in combination with 1 to 5 lbs. of pentachlorophenol, were also made during the post-harvest period after discing. The retreatment sprays were made when the asparagus was 24 to 30 inches high and the sprays were directed at the base of the plants. 1.0 and 2.0 lbs. of sodium salt and 1.0 lb. of alkyl ester, applied after the first cutting, did not give satisfactory weed control for more than three weeks. Retreatment, with 2.0 lbs. alkyl ester, four weeks into the cutting season, gave excellent weed control, particularly of Canada thistle, through the rest of the cutting season. The 3.0 lbs. sodium salt and 2.0 and 3.0 lbs. alkyl ester gave fair to good weed control for six weeks, when applied after first cutting. None of the 2,4-D treatments resulted in any visible damage to asparagus, except where exposed spears were sprayed.

The best weed control, in the post-harvest season, was obtained where 2.0 lbs. alkyl ester was applied and followed immediately with 50 gallons aromatic oil, containing 1.0 lb. pentachlorophenol. This treatment completely eliminated weeds for six weeks and, as of October 15, there was practically no weed competition. Slight burning at the base of some spears was noted a few days after spraying, but this was apparently minor in relation to the development of plants during the season. (Contribution of the Department of Horticulture, Ohio Agricultural Experiment Station, Columbus, Ohio.)

3 The effect of various pre-emergence treatments on the yield of snap and lima beans. Alban, E. K., Leslie McCombs, and Webster Smith. During the 1948 season, Giant Stringless Green Pod, Round Pod Kidney Wax, Fordhook 242, and Henderson Bush varieties of beans were planted (Brookston silt loam) in a randomized block, with twelve treatments, replicated three times. The alkyl ester and the sodium salt of 2,4-D, at 0.5 and 1.0 lbs., acid equivalent, per acre in 20 gallons of water were applied one and six days after planting. Dow Selective, at 5 pints per 100 gallons; Dow General, at 2 pints per 100 gallons; and 50 gallons aromatic oil (15%) plus 1.0 lb. PCP, were applied six days after planting. One check, or untreated, replicated plot was included. All plots were hoed and cultivated July 1 and cultivation was continued, as needed, through the season. Excellent weed control was obtained with all 2,4-D applications and fair to poor weed control with dinitro, and oil sprays. The major weeds included lambs-quarters, purslane, galinsoga, smart weed, foxtail and crabgrass. The 2,4-D treatments caused visible damage to all varieties of beans but did not materially affect the stand. The lima bean varieties were least affected by the 2,4-D applications and Henderson Bush seemed particularly resistant. Round Pod Kidney Wax was damaged more severely than Giant Stringless Green Pod.

Statistically significant reduction in yield occured following the application of 0.5 and 1.0 lbs. of alkyl ester and sodium salt, six days after planting, with both varieties of snap beans. There were no statistically significant differences in yield of lima beans following any of the 2,4-D, dinitro, or fortified oil applications. (Contribution of the Dept. of Horticulture, Ohio Agricultural Experiment Station, Columbus, Ohio)

4 Effect of several pre-emergence treatments on weed control and the growth and yield of lima beans. Warren, G. F. A replicated experiment was conducted on Henderson Bush lima beans planted two inches deep in a silt loam soil on June 16. On June 17, the sodium salt of 2,4-D at 1 and 2 pounds of acid equivalent per acre, Dow Selective at 6 gallons (13.7% ammonium dinitro-secondary-butyl phenate), sodium pentachlorophenate at 25 pounds, ammonium salt of TCA at 5 and 10 pounds of acid equivalent, and a combination of TCA at 10 pounds and 2,4-D at 1 pound, were applied as aqueous sprays to the soil surface. Precipitation, as light showers, totaled 1.05 inches, during the next two weeks, but there were no heavy rains until July 20. Weed counts were made and the weeds removed from all plots four weeks after planting. Sodium pentachlorophenate and 2,4-D gave 80 to 100 percent reductions in the stands of pigweed (Amaranthus retroflexus), purslane (Portulaca oleracea) and witchgrass (Panicum capillare) but only 30 to 65 percent for foxtail (Setaria spp.); the 2 pound rate of 2,4-D giving the greatest reduction in stand of the latter weed. Dow Selective gave good control of purslane but only 30 to 50 percent control of the other three weeds. TCA had little or no effect on purslane and pigweed but gave 82 to 96 percent control of the grasses. The combination of TCA and 2,4-D gave practically perfect control of all weeds present. One and 2 pounds of 2,4-D significantly reduced the stand of lima beans by 8 and 14 percent, respectively. The other treatments did not affect the stand. The yield was not reduced by 2,4-D, Dow Selective, or sodium pentachlorophenate, but all plots that received TCA failed to produce any beans. Plants on the latter plots were stunted and distorted throughout the season. (Contribution of the Department of Horticulture, University of Wisconsin, Madison, Wisconsin.)

5 The effect of various oil sprays on weeds in carrots. Carder, A. C. Five oil sprays, stove oil, Varsol, Stoddard solvent, tractor distillate #1, and Shell Weedkiller #1, were compared with cultivation as a means of controlling weeds in carrots (variety Chantenay). The sprays were applied to the entire field area at 80 gallons per acre. Treatment was made when the carrots were in the four true leaf stage. Weeds involved were seedling stinkweed (Thlaspi arvense) and lamb's quarters (Chenopodium album). Stoddard solvent, Varsol and Shell Weedkiller #1 gave almost 100 percent elimination of weeds without injury to the young carrots, while tractor distillate #1 and stove oil, though killing all weed growth, had a slight scalding effect on the carrots, which retarded them somewhat. The carrots were harvested, for over-winter purpose, 70 days after treatment and contained no tainted flavor. Yield data were rendered meaningless by the extreme patchiness of the stand due to irregular germination. (Contribution of Dominion Experimental Station, Beverlodge, Alberta, Canada.)

6 The effect of various pre-emergence and post-emergence applications of 2,4-D salt and ester formulations on the maturity and yield of four sweet corn varieties. Alban, E. K., Leslie McCombs, and Homer Swingle. During the 1948 season, Spancross, Marcross, Golden Cross Bantam, and Ioana varieties of sweet corn were planted (Miami silt loam) in a randomized split block arrangement with 32 treatments replicated three times. The alkyl ester and sodium salt, at 1.0 and 2.0 lb., acid equivalent, in 20 gallons total volume of water per acre, were applied 2, 4, and 8 days after planting, as corn pre-emergence treatments. Post-emergence applications of 0.125, 0.25, and 0.50 lbs. of alkyl ester, and 0.25, 0.50, and 1.0 lbs. of sodium salt, were made when the corn was two and nine inches high. With the corn 18 inches high, 0.24, 0.50, 1.0 lbs. of alkyl ester and 0.50, 1.0, and 2.0 lbs. of sodium salt, were applied as post-emergence treatments. Two check, or untreated, replicated plots were also included. All plots were hoed, as needed, cultivated at 49 days after planting, and this was the only cultivation through the season. The alkyl ester, in all instances, gave better weed control than the same rates of the sodium salt. All varieties of sweet corn were visibly damaged when sprayed at the 18 inch height, with the higher rates of the alkyl ester. There were no statistically significant differences in stand, maturity, or total yield of any variety of sweet corn, as related to any of the 2,4-D treatments. (Contribution of Department of Horticulture, Ohio Agricultural Experiment Station, Columbus, Ohio.)

7 Effect of pre-emergence sprays with two formulations of 2,4-D on sweet corn. Andersen, E. T. and A. B. Mantell. The butyl ester and sodium salt of 2,4-D, at rates of 0.25, 0.50, 1.0, and 2.0 pounds (pure acid equivalent) per acre, were applied in spray form to Marcross sweet corn. Applications were made just after seeding and just before emergence of the corn. Analysis of yield data (dry kernel weight) indicated no statistically significant reduction in yields with any of the treatments applied at either date. Similarly, there was no reduction in length or form of ears. Relatively few weeds were present at the time of treatment. However, at a later date, the first crop of weeds, which was predominately red-root pigweed (Amaranthus retroflexus) and purslane (Portulaca oleracea) emerged fairly uniformly over the entire planting. The entire block was cultivated 10 days after emergence of the corn, destroying a dense stand of weeds. Shortly following this cultivation, heavy rains induced new weed growth. A striking effect was noted in that plots which had previously been treated remained essentially free of weeds. This effect was evident in all treatments, although weed control could

not be considered satisfactory with the 0.25 pound rate. The two formulations behaved similarly in producing this effect. (Contribution of Division of Plant Science, University of Manitoba.)

8 Effect of pre-emergence sprays with two formulations of 2,4-D on onions. Anderson, E. T. and A. B. Mantell. The butyl ester and sodium salt of 2,4-D, at rates of 0.25, 0.50 and 1.0 pound, acid equivalent, per acre, were applied in spray form to Yellow Globe Danvers onions. Applications were made two days after seeding and just before emergence of the crop. Analysis of yield data (bulb weight) indicated statistically significant reduction in yields with the ester applied at the second date. The reduction in yields resulted primarily from reduced emergence and stand of the onions. Bulbs from treated plots were equal in size and development to those from the non-treated plots. (Contribution of Division of Plant Science, University of Manitoba.)

9 The control of weeds in onions. Bakke, A. L. For the successful chemical weeding of onions, it is necessary for the onion plant to have reached the three-leaf stage of development, while the weeds are small. At that time, the onion plant can be sprayed with several kinds of selective herbicides without injury. The yields, in pounds, derived from .025 acre plots in a northern Iowa peat bog, where the spraying was at a rate of 100 gallons of solution per acre, and where there was a small amount of hand weeding, were as follows: Sulfuric acid 2.5 percent, 1140; Santobrite (sodium pentachlorophenate) per 100 gallons, 1050; Santobrite, 4 lbs. per 100 gallons, 833; Sinox, 3 pints per 100 gallons, 721; Sinox dust, 533; Acrocyanate, 2 percent, 866; Dow Selective, 689; Control, 680. When the spray applications were delayed, causing the weeds to become larger, the yields were reduced.

Weeds in onions may be controlled through pre-emergence applications of Stanisol (Stoddard solvent), sodium pentachlorophenate, pentachlorophenate in Diesel oil, amine salt of 2,4-D, ester formulation of 2,4-D. Of the chemicals tested, the ester formulation of 2,4-D gave the best weed control. There was no decrease in yield. (Iowa Agricultural Experiment Station)

10. Comparison of the effects of 2,4-D pre-emergence treatments on onions from seed and sets on peat and silt loam soils. Hernandez, T. P. Replicated experiments using Golden Globe onions, grown from seed and sets were conducted both on Miami silt loam soil and peat soil, less than one mile apart, to compare the injury to the onions from 2,4-D pre-emergence treatments. Plots, on both soil types, were planted at the same time and treated the same throughout the season. A sodium salt, containing 80.5% 2,4-D acid was applied at the rates of 2 and 4 pounds of 2,4-D, acid equivalent, per acre on the two soil types one day after planting and six days after planting. Good control of pigweed (Amaranthus retroflexus) and purslane (Portulaca oleracea) resulted from the 2,4-D treatments on both soil types, except that on silt loam soil, where the 2,4-D was applied one day after planting, only fair control was obtained. The pre-emergence treatments of 2,4-D on the silt loam soil killed practically all of the onions from seeds, whereas, on the peat soil, no significant reduction in yield resulted. The same pre-emergence treatments, on onions grown from sets, gave a highly significant reduction in yield on the silt loam soil, but not on the peat soil. The injury to the onions was generally greater when the pre-emergence treatments were applied one day after planting than when applied six days after planting. (Contribution of Department of Horticulture, University of Wisconsin, Madison, Wisconsin.)

11 A study of the chemical control of weeds in onions. Nylund, R. E. In 1948, 3% Sulfuric acid, 25% Sodium Chloride, 25% Potassiam Chloride, Aero Cyanate, Sodium orthophenylphenate, Sodium 2, 4, 5 trichlorphenate, and Sodium 2,3,4,6 tetrachlorphenate, at several concentrations each, were applied at the rate of 100 gallons per acre to seeded onions at the one-leaf stage of growth. Of the 15 formulations applied, only 1.5% and 2% trichlorphenate, 3% sulfuric acid, and 2% Aero Cyanate gave significant control of weeds. None of the formulations applied reduced stands and yields of onions. One week after first application of herbicides, a second application was made to 8 of the 16 replications in the test using a double concentration of all treatments, except 25% sodium chloride, 25% potassiam chloride, 3% sulfuric acid, and 2% sodium trichlorophenate. The second application of herbicides resulted in significant control of weeds with all treatments. However, only six of the treatments were effective in controlling weeds without reducing stands and yields of onions. The treatments in order of herbicidal efficiency were: (1) 3% sulfuric acid followed one week later by 3% sulfuric acid, (2) 1% followed by 2% sodium tetrachlorphenate . (3) 1% followed by 2% Aero Cyanate, (4) 1.5% followed by 3% sodium orthophenylphenate, (5) .75% followed by 1.5% sodium tetrachlorphenate, and (6) 25% sodium chloride followed by 25% sodium chloride. Principal weed species present at the time of application of the herbicides were shepherd's purse (Capsella bursa-pastoris, (L.) medic.) 57%, Red-root pigweed (Amaranthus retroflexus, L.) 26%, and Barnyard Grass (Echinochloa crus-galli, (L.) Beaux.) 10%. (Paper No. 638 of the Miscellaneous Journal Series of the Minnesota Agricultural Experiment Station, St. Paul, Minnesota.)

12 Comparison of 2,4-D with contact herbicides for pre-emergence weed control in onions. Warren, G. F. Replicated experiments were conducted on onions seeded approximately one inch deep in peat soil, using Early Yellow Globe at two locations and Brigham Yellow Globe at another. Just before onion emergence (11 to 15 days after planting), the sodium salt of 2,4-D at 0.50, 1 and 2 pounds of acid equivalent per acre, diesel fuel at 25 and 50 gallons and a 2 percent solution of Dow Contact Herbicide at 25 and 50 gallons, were applied as sprays to the soil surface. Many weeds were up at this time. Precipitation at all locations during the two weeks following the applications was less than one inch. Weed counts were made five to six weeks after planting and the weeds were removed from all plots at this time and subsequently throughout the season. The average reduction in stands of weeds, which included pigweed (Amaranthus retroflexus), purslane speedwell (Veronica peregrina) and several species of annual grasses, was 61, 70, and 77 percent respectively for 0.50, 1 and 2 pounds of 2,4-D. Diesel fuel reduced the number by 46 and 54 percent, and Dow Contact by 36 and 57 percent for the 25 and 50 gallon rates respectively. Purslane (Portulaca oleracea) was present in one of the experiments, but none of it had emerged when the treatments were applied. Excellent control of this weed was obtained with 2,4-D, whereas, the contact herbicides, diesel fuel and Dow Contact, gave practically no control. In the latter experiment, there was no apparent injury to the onions from any of the treatments but at the other two locations, Dow Contact, at 50 gallons per acre, caused over 35 percent reductions in the stand of onions and smaller reductions in yield. The stand and yield was not reduced by any other treatment at any of the locations. (Contribution of the Department of Horticulture, University of Wisconsin, Madison, Wisconsin.)

13 Comparison of three 2,4-D formulations with other growth regulators for pre-emergence weed control in onions. Warren, G. F. A replicated experiment was conducted on Brigham Yellow Globe onions, planted approximately one inch deep in peat soil. Eleven days after planting, the sodium salt, amine salt, butyl ester of 2,4-D, amine salts of MCP, and 2,4,5-T were applied as aqueous sprays to the soil surface at the rates of one and 2 pounds of acid equivalent per acre. Precipitation during the two weeks following the applications was .86 inches. Weed counts were made 5 and 8 weeks after planting and the weeds were removed from all plots at these times and subsequently throughout the season. The average reduction in stand of weeds 5 weeks after planting, which were primarily pigweed (Amaranthus retroflexus) and purslane (Portulaca oleracea), was 71, 72, 79, 75, and 53 percent for the 1 pound rate of the sodium salt, amine and ester formulations of 2,4-D, the amine formulations of MCP and 2,4,5-T respectively. At the 2 pound rate, the reductions in the above order were 78, 84, 89, 79, and 47 percent. There were no significant differences in weed numbers at the time the second counts were made (8 weeks after planting), indicating that the effect of the treatments had been dissipated. The 2 pound application of MCP reduced the stand of onions by 24 percent, but did not reduce the yield. No other treatment had any significant effect on the stand or yield of onions. (Contribution of the Department of Horticulture, University of Wisconsin, Madison, Wisconsin)

14 Effect of rainfall on injury to onions from 2,4-D pre-emergence sprays. Warren, G. F. Several replicated experiments, as well as numerous field trials, were conducted on Early Yellow Globe and Brigham Yellow Globe onions seeded in peat soil at five locations. Just before onion emergence, the sodium or amine salt of 2,4-D was applied as a spray to the soil surface. Weeds were removed by hand throughout the season before they were large enough to cause competition with the onions. In three experiments, where rainfall during the two weeks after treatment was less than 1 inch, there was no reduction in stand or yield of onions at rates up to 2 pounds of 2,4-D acid equivalent per acre. In field trials, with similar rainfall after the treatments were made, there was also no apparent reduction in stand or yield. In an experiment where 2.73 inches of precipitation occurred in the two weeks following application of the sprays, 2 and 4 pounds per acre significantly reduced the stand of onions by 9 and 16 percent respectively. In a field trial, with precipitation of over 4 inches during the two weeks following the application of 1.25 pounds of 2,4-D, onions that had been planted 5 days when treated were all killed before emergence and those that had been planted 14 days when treated (about 15 percent emergence) were reduced in stand by approximately 75 percent. Other factors, no doubt, influenced these results but rainfall immediately following treatment seemed to be of importance. (Contribution of Department of Horticulture, University of Wisconsin, Madison, Wisconsin.)

15 Some effects of 2,4-D spray applications on Sebago potatoes. Peterson, Clinton E. The specific gravity of Sebago tubers, from plots sprayed with 40% butyl ester of 2,4-D at 0.25 lb., acid equivalent, per acre in 100 gallons of water, was 1.071 compared with 1.066 for unsprayed check. Spray treatment at 1, 2, and 4 lbs. of the acid per acre, in the form of ammonium salt, produced no significant change in specific gravity of tubers. Broad leaved weeds were effectively controlled and no significant reduction in yield occurred. Butyl ester spray, in 1947, caused profuse setting of parthenocarpic fruit while the ammonium salt treatments, in 1948, caused complete abscission of flowers and buds.

Plants receiving 2 and 4 lb. ammonium salt were much earlier in maturity than check plants. All plants in these plots were dead September 21. Plots receiving the one pound treatment were 90% dead on that date and the check was still green. These results suggest the possibility of using 2,4-D as a vine killing agent as well as a selective herbicide for weed control.

16 The effect of depth of planting, soil type, time of application, rate and form of 2,4-D on varieties of peas, onions, snap and lima beans, sweet corn, and asparagus. Alban, E. K., Leslie McCombs, Homer Swingle, and Webster Smith. Standard flats were filled with a Miami silt loam and a mixture of 3 parts Miami silt loam and 1 part sand. Varieties of the above vegetables were planted deep and shallow (onions 1.5 and 1.0 inch, all other vegetable seed at 1 and 2 inches) in the two soil mixtures. The alkyl ester at 1.0 lb. and the sodium salt at 1.0 and 2.0 lbs. acid equivalent, per acre were applied in 25 gallons total volume of water as separate treatments for each soil type, planting depth, and kind of vegetable. One series of flats were treated at time of planting, the second series 3 to 9 days after planting, and the third series 4 to 23 days after planting, depending upon the kind of vegetable. All 2,4-D applications were crop pre-emergence. All flats were watered to maintain moist soil.

Better weed control and greater crop damage was evident on sandy soil as compared with the loam soil. Depth of planting was of little consequence with sweet corn and asparagus, but with beans, peas, and onions, shallow planted seed was damaged more than the deeper planting. The form of 2,4-D did not affect crop damage or weed control, but the higher rate increased damage to some crops. Greater crop damage resulted from 2,4-D treatments at time of planting than with either of the other times of application with beans, onions, and peas. Sweet corn and asparagus were rather tolerant of 2,4-D treatments regardless of depth of planting, time of treatment, or soil type. Tolerance of these two crops appeared to be associated with a more rapid recovery following treatment, rather than complete resistance. Damage to peas, onions, and beans from pre-emergence treatments was rather severe with most treatments. Considerable difference in varietial susceptibility was noted with sweet corn, beans, onions, and peas. (Contribution of the Department of Horticulture, Ohio Agricultural Experiment Station, Columbus, Ohio.)

17 A study of the control of weeds in beets, onions and carrots by pre-emergence applications of herbicides. Nylund, R. E. On April 23, 1948, beets, carrots, and onions were seeded in a well drained muck soil which had been prepared for seeding on the previous day. Seven days after seeding, at which time numerous small weeds were present but crop plants had not yet emerged, the following herbicidal treatments were applied to square-rod plots: weed burner, Stoddard solvent, Amsco D, 2% Dow Contact, 20% H.A.N. #132, 3% sodium 2,3,4,6 tetrachlorphenate, 3% sodium pentachlorphenate, 3% sodium 2,4,5 trichlorphenate, and the sodium salt of 2,4-D at 1, 2, and 4 lbs. of acid equivalent per acre. All sprays were applied at 80 gallons per acre except the H.A.N. #132, which was applied at 160 gallons per acre. Temperature at the time of application was 50° F., humidity was high, and the soil was moist. Principal weed species present were Shepherd's purse (Capsella bursa-pastoris (L.) Medic.) 57%, Red-root pigweed (Amaranthus retroflexus, L.) 26%, and Barnyard Grass (Echinochola crus-galli, (L.) Beaux.) 10%. The effects of the herbicidal treatments varied for the three crops. With beets, Amsco D, H.A.N. #132, weed burner, and Stoddard solvent were the only treatments which significantly reduced weed populations without reducing stands and yields of

the crop. With carrots, only Amsco D, the weed burner, and Stoddard solvent killed weeds without adversely affecting yields. With onions, only the weed burner and Stoddard solvent were effective in controlling weeds without injuring onions. All of the other treatments, with the exception of 1 lb. of 2,4-D per acre, significantly reduced weed growth but seriously injured the crop plants. (Paper No. 636 of the Miscellaneous Journal Series of the Minnesota Agricultural Experiment Station, St. Paul, Minnesota.)

18 Pre-emergence weed control in vegetables. Wilson, J. D., H. E. Bruner, and W. E. Hall. 16 of 19 herbicidal formulations, mostly pentachlorophenols, dinitros, and 2,4-D, applied to potatoes just as the first plants were coming up (May 12) gave good control of weeds (chiefly smartweed) for several weeks. Sodium pentachlorophenate in water, and 2,4-dinitro secondary butyl phenol in aromatic oil, were slightly injurious to the potatoes. 2,4-D, as the sodium salt and as the amine, checked weeds effectively, but at the same time, caused leaf deformation so severe that no normal leaves were produced for six weeks.

Eight to twelve vegetables were planted in adjacent rows in duplicated plots and sprayed crosswise with 18 to 20 weed-killing formulations, just before emergence, in experiments started on three different dates. Corn was found to be best able to survive this type of treatment. Snap beans and cucumbers ranked second and third, respectively, in survival power. All three of these posess comparatively large seeds. Tomato, cabbage, carrot, and lettuce, small seeded vegetables, were very sensitive to injury in most instances. Again, the dinitro compounds in oil, sodium pentachlorophenate in water, and various forms of 2,4-D, were most injurious to the vegetables but gave good weed control. The best balance between control of smartweed, purslane, red root, shepherd's purse, and vegetable survival was obtained with various formulations of either pentachlorophenol or Sulfasan (Xanthogen disulfide) in aromatic oil. (Contribution of the Experiment Station, Wooster, Ohio.)

19 Control of dandelions in strawberries by 2,4-D. Carder, A. C. Rates of 8, 16, and 32 ounces, acid equivalent, per acre of a butyl ester of 2,4-D were applied at three growth stages of Dakota strawberry, viz., just previous to flowering, at time of flowering, and in late summer after harvest. The strawberry plants showed no injury from the 8 and 16 ounce rates but exhibited curling of leaves from the 32 ounce spraying at time of flowering. Most complete kill of the dandelions was effected by treating before the strawberry plants were in flower, at which time, the dandelions were in full flower. Spraying at this time eliminated the dandelions 55, 70, and 80 per cent with the 8, 16, and 32 ounce rates respectively. Many old established dandelions had only their tops killed and later fully recovered. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta, Canada.)

20 Weed control in an established strawberry (variety Premier) planting with 2,4-dichlorophenoxyacetic acid. Davidson, J. H. Early spring sprays of .5 and 1 lb. of 2,4-D acid, sodium salt and amine salt, were applied just as growth was beginning in mid-April. The sprays were applied with a power sprayer at the rate of 135 gallons per acre. The predominant weed growing in the planting was wild lettuce (Lactuca spp.). Other weeds present were wild geranium (Geranium carolinianum), vetch (Vicia spp.) and dandelion (Taraxacum spp.). At equivalent 2,4-D acid concentrations, the amine salt gave better control of the wild lettuce. Vetch and wild geranium were controlled by both the sodium and amine salts. The established dandelions were not visibly affected by any of the treatments. The one pound concentrations caused slight formative effects on the new strawberry foliage, which emerged

immediately after treatments. Later growth and fruiting appeared normal. (Contribution of the Dow Chemical Company, South Haven, Michigan)

21 A study on the use of 2,4-D for weed control in strawberries. Nylund, R. E. The isopropyl ester of 2,4-D at three rates, 0.25, 0.50, and 1 lb. of 2,4-D acid equivalent, per acre and the sodium salt of 2,4-D at four rates, 1, 2, 3, and 4 lbs., acid equivalent, per acre, were applied to late-planted (June 21) Arrowhead strawberry plants on July 9, 1948. All materials were applied at the rate of 80 gallons of solution per acre. Each treatment was applied to ten randomized plots, each plot consisting of a single 30 foot row. Principal weed species present were red-root pigweed (Amaranthus retroflexus, L.) and purslane (Portulaca oleracea, L.). The isopropyl ester at 1 lb. per acre and the sodium salt at 1 and 2 lbs. per acre, satisfactorily controlled broad-leaved weeds for the remainder of the growing season. The ester at 0.25 and 0.50 lbs. and the sodium salt and 1 and 2 lbs. acid per acre, practically eliminated broad-leaved weeds for a period of five weeks, at which time (Aug. 11) a second application of these formulations and rates was made. Broad leaved weeds were satisfactorily controlled by the second application and the plots remained free of weeds for the remainder of the season. Some distortion of the leaves and runners of the strawberry plants was noticeable after the July 9 application, praticularly on the plots receiving the high rate of isopropyl ester and the two higher rates of sodium salt. Leaf counts, on August 11, and runner plant counts, on August 11 and September 21, indicated no detrimental effect of the 2,4-D on either leaf production or on runner plant formation. (Paper No. 637 of the Miscellaneous Journal Series of the Minnesota Agricultural Experiment Station, St. Paul, Minnesota.)

22 A preliminary report on spraying strawberries with 2,4-D and TCA. Slife, F. W. and H. L. Ball. Strawberry seedlings were sprayed in August, 1948, with 0.25, 0.50, 0.75, 1.0, 2.0, 3.0, and 4.0 pounds of 2,4-D acid equivalent, per acre in the ester, amine and sodium salt formulations. Some seedlings were severely affected at the 0.50 rates, while others were affected only slightly at the 4 pound rates.

Premier, one of the standard varieties in Illinois, was sprayed with 0.50, 0.75, 1.0, 2.0 and 3.0 pounds per acre of the amine preparation on August 20, 1948. The twisting and curling effect was slight on the 0.50 and 0.75 pound application, but rather severe on the 1, 2 and 3 pound rates. Within one month from application, all plots appeared normal and showed no apparent effects of treatment. Yields will be obtained from these plots in 1949.

TCA was applied to the Premier variety, at the rates of 10, 20, 30, 40 and 50 pounds, acid equivalent, per acre. In all plots, plants were severely burned and on October 15, there was no evidence of recovery. (Contribution of Illinois Agricultural Experiment Station.)

23 Control of grasses in raspberry plantings by fall, spring, and summer applications of sodium trichloroacetate. Carlson, R. F. and J. E. Moulton. Applications of TCA at concentrations of 10, 30, and 60 pounds TCA, acid equivalent, per acre to rows of Latham raspberry plants were made in November, 1947, and April and July, 1948. The planting was severely infested with quack grass (Agropyron repens L.) and Kentucky blue grass (Poa pratensis L.). The fall applications of 30 and 60 pounds per acre controlled the grasses without injury to the raspberry plants, whereas, 10 pounds per acre only reduced the

stand of grasses. The spring application, at the same rates per acre, gave comparable control of the grasses but minor chlorotic effects were observed on the new foliage of the raspberry plants. The July application gave similar control of the grasses but the raspberry plants were severely injured, as was indicated by yellowing of the foliage and stanting of the younger shoots. Kentucky blue grass appeared to be a little more resistant to the chemical than quack grass. (Contribution of Department of Horticulture, Michigan State College, East Lansing, Michigan.)

24 Trichloroacetic acid, sodium salt, for the control of annual blue grass (Poa annua) and quack-grass (Agropyron repens) growing in certain horticultural crops. Davidson, J. H. and L. L. Coulter During 1948, sprays containing TCA were applied at rates of 19, 37, and 74 pounds TCA, acid equivalent, per acre in 300 gallons of water. These treatments were used alone, and in combination with 0.5 lb. and 1 lb. of 2,4-D, sodium salt, per acre. Two series of treatments were made, the first in mid-April, the second, one month later. The treated grass plots included blueberries, black raspberries, peaches, and cherries. All treatments have good control of Poa annua in the blueberry planting. The higher concentrations were necessary for quack grass control. Chlorosis, and some marginal leaf necrosis, was noted on all crops at the concentrations used. Severity of the injury increased with the higher concentrations. Injury did not become apparent, in all cases, until two months after application. Inclusion of 2,4-D did not affect the degree of control or the amount of injury. On asparagus, 62, 124, and 248 lbs. TCA, acid equivalent per acre resulted in good quack grass control but injured the asparagus. (Contribution of the Dow Chemical Company, South Haven, Michigan.)

25 Use of Stoddard solvent for weed control in seedling evergreens. Koski, Sulo O. Stoddard solvent was applied at the rate of 64 gallons per acre to seedling cedars (Juniperus scopulorum and J. virginiana) and Ponderosa pine (Pinus ponderosa) 15 days after emergence with no mortality and no apparent injury, except for a slight yellowing of needle tips of the pine. Two and three-year-old juniper and pine were sprayed with 82 gallons per acre with identical results.

On the basis of the past seasons experience, it is suggested that application be made either on a cool day, in the evening or immediately after rain or irrigation to reduce the danger of burning.

Application should be made with a nozzle delivering a fine spray to insure even distribution.

All grasses treated, proved susceptible, as did most broad leaved species. Mares tial (Erigeron canadense) proved resistant. The use of this herbicide reduced weed costs about 80%. (Contribution of Soil Conservation Service Nursery, Waterloo, Nebraska.)

26 Effect of organic matter content on the rate that 2,4-D is leached in different soils. Hernandez, T. P. Mineral soils with different amounts of organic matter, and a peat soil, were used in greenhouse experiments to determine the rate at which 2,4-D is leached with varying quantities of water. A sodium salt containing 70% of 2,4-D acid was used at the rate of 2, and 4 lbs. per acre. The indicator plant used to determine the residual toxicity of 2,4-D was cabbage (Variety Wisconsin Hollander) grown from seed in the several layers of soil tested. The 2,4-D was added to the soil surface as an aqueous solution.

The results showed that in mineral soils, low in organic matter, the 2,4-D was much more readily leached than in mineral soil high in organic matter, or in peat soil. In mineral soils, with 0.25% and "% organic matter, one surface inch of water was sufficient to move 2,4-D in highly toxic concentration to a depth of at least 5 inches into the soil when 2 pounds or more of 2,4-D per acre was applied to the soil surface. In mineral soil with 9% organic matter or in the peat soil, using 4 pounds of 2,4-D per acre, 4 surface inches of water only moved the 2,4-D in slightly toxic concentration to a depth of 3 inches. (Contribution of Department of Horticulture, University of Wisconsin, Madison, Wisconsin.)

27 Factors affecting the rate of inactivation of 2,4-D in peat soil. Hernandez, T. P. Experiments were conducted in the greenhouse to determine the effects of temperature, soil sterilization, and moisture levels on the rate of inactivation of 2,4-D in peat soil. A sodium salt, containing 70% of 2,4-D acid was used at the rate of 4 pounds, acid equivalent, per acre. The indicator plant used to determine the residual toxicity of 2,4-D in the soil, was cabbage (variety Wisconsin Hollander) grown from seed in the soil tested. The 2,4-D was added to the surface soil as an aqueous solution. Results on the effects of temperature on the rate of inactivation of 2,4-D showed that at 75° F. the 2,4-D in moist peat soil was inactivated at the end of 4 weeks of storage. At 40° F. the 2,4-D was still toxic at the end of 8 weeks of storage, but was inactivated at the end of 12 weeks. When moist peat was sterilized, 2,4-D was found to be completely toxic at the end of 12 weeks, whereas, in unsterile soil it was inactivated at the end of 2 weeks. Sterilizing the soil alone, as shown by the control, reduced the germination and growth of the cabbage plants somewhat. In a warm greenhouse, 2,4-D was found to be toxic in air-dry peat soil at the end of 16 weeks of storage; however, in both moist and water saturated peat soil, the 2,4-D was inactivated at the end of 2 weeks. (Contribution of Department of Horticulture, University of Wisconsin, Madison, Wisconsin)

28 Soil fumigation with methyl bromide for control of weeds and nematodes in seed beds. Dieter, C. E. and L. L. Coulter. Pre-planting application of methyl bromide MC-2 (methyl bromide containing 2% chloropicrin as a warning agent), under a gas-proof covering, has shown effective control of weeds and nematodes in seed beds. Methyl bromide, at rates of 0.5, 1 and 2 pounds per 100 square feet, was used at exposures of 24 and 48 hours. Satisfactory results were obtained from all treatments when the soil was in good seed bed condition. Similar treatments, applied to very dry soil, or to soil saturated in the top level, did not give as complete control. There are indications that both dormant and germinating seeds were killed, at least in the area above the plow sole. In addition, both root knot and the meadow type nematode were controlled. The methyl bromide was released under the gas-proof covering with a Jiffy applicator attached to a Saran tube. The covering was supported 3 to 4 inches above the area to be treated and the edges sealed with soil. Methyl bromide is a poisonous gas and should be used with extreme caution. 48 hours should elapse after removal of the covering before planting. (Contribution of the Dow Chemical Company, South Haven, Michigan.)

The results showed that in mineral soils, low in organic matter, the 2,4-D was much more readily leached than in mineral soil high in organic matter, or in peat soil. In mineral soils, with 0.25% and 4% organic matter, one surface inch of water was sufficient to move 2,4-D in highly toxic concentration to a depth of at least 5 inches into the soil when 2 pounds or more of 2,4-D per acre was applied to the soil surface. In mineral soil with 7% organic matter or in the peat soil, using 4 pounds of 2,4-D per acre, 4 surface inches of water only moved the 2,4-D in slightly toxic concentration to a depth of 3 inches. (Contribution of Department of Horticulture, University of Wisconsin, Madison, Wisconsin.)

57 <u>Factors affecting the rate of inactivation of 2,4-D in peat soil.</u> Fernandes, V. P.. Experiments were conducted in the greenhouse to determine the effects of temperature, soil sterilization, and moisture levels on the rate of inactivation of 2,4-D in peat soil. A sodium salt, containing 70% of 2,4-D acid was used at the rate of 4 pounds, acid equivalent, per acre. The indicator plant used to determine the residual toxicity of 2,4-D in the soil, was cabbage (variety Wisconsin Ballhead) grown from seed in the soil treated. The 2,4-D was added to the surface soil as an aqueous solution. Results on the effects of temperature on the rate of inactivation of 2,4-D showed that at 75° F. the 2,4-D in moist peat soil was inactivated at the end of 4 weeks of storage. At 40° F. the 2,4-D was still toxic at the end of 8 weeks of storage, but was inactivated at the end of 12 weeks. When moist peat was sterilized, 2,4-D was found to be completely toxic at the end of 12 weeks, whereas, in nonsterile soil it was inactivated at the end of 2 weeks. Sterilizing the soil alone, as shown by the control, reduced the germination and growth of the cabbage plants somewhat. In a warm greenhouse, 2,4-D was found to be toxic in air-dry peat soil at the end of 16 weeks of storage; however, in both moist and water saturated peat soils, the 2,4-D was inactivated at the end of 2 weeks. (Contribution of Department of Horticulture, University of Wisconsin, Madison, Wisconsin)

58 <u>Soil fumigation with methyl bromide for control of weeds and nematodes in seed beds.</u> Dieter, C. E., and L. L. Danielson. Pre-planting application of methyl bromide MC-2 (methyl bromide containing 2% chloropicrin as a warning agent), under a gas-proof covering, has shown effective control of weeds and nematodes in seed beds. Methyl bromide, at rates of 0.5, 1 and 2 pounds per 100 square feet, was used at exposures of 24 and 48 hours. Satisfactory results were obtained from all treatments when the soil was in good seed bed condition. Similar treatments, applied to very dry soil, or to soil saturated in the top inch, did not give as complete control. There are indications that both dormant and germinating seeds were killed, at least in the area above the plow sole. In addition, both root knot and the meadow type nematode were controlled. The methyl bromide was released under the gas-proof covering with a fifty applicator attached to a Saran tube. The covering was supported 3 to 4 inches above the area to be treated and the edges sealed with soil. Methyl bromide is a poisonous gas and should be used with extreme caution. 48 hours should elapse after removal of the covering before plantings. (Contribution of the Dow Chemical Company, South Haven, Michigan.)

PROJECT V INVESTIGATION OF WEED CONTROL METHODS IN HORTICULTURAL AND TRUCK CROPS, POTATOES, SUGAR BEETS, LEGUMES, ETC.

E. A. Helgeson, Leader

Summary of Regional Studies on:

Legumes and miscellaneous crops

Sodium salt, amine, and ester formulations of 2,4-D were applied to soybeans at rates varying from 1/48 to 4 pounds acid equivalent per acre. In general, where there was adequate control of broadleaf weeds, injury to soybeans was excessive and grass weeds were not injured. Maturity of the crop was delayed and yields were reduced to a significant degree. In one case, however, three varieties showed no reduction in yield when treated at the rate of $\frac{1}{4}$ pound per acre. The most resistant stages of soybeans to 2,4-D appeared to be the cotyledon and flowering stages. One-half pound of 2,4-D did not damage sesame, safflower, castor beans, perilla and sunflower, nor were weeds controlled. All these crops were injured to some extent and there was good weed control at 1 and 2 pounds per acre. Pre-emergence application of 2,4-D to garden peas reduced yields by reducing stands. Distorted plants recovered during the season. Rates of 2,4-D sufficient to kill broadleaf plantain, curled dock, narrowleaf plantain and Canada thistle killed red clover but only set back Ladino clover which recovered and set seed well.

Ammonium and sodium trichloroacetate were sprayed on soybeans at rates ranging from 5 to 100 pounds per acre. Grass weeds were well controlled only at rates of 25 to 50 pounds and more per acre. The leaves of soybeans were curled and brittle. Maturity was delayed about two weeks and yields were reduced significantly even at the lower rates. Both formulations of TCA affected sesame, safflower, castor beans, perilla and sunflower at rates of 25 and 50 pounds per acre with no weed control.

Soybeans treated with a dinitro (Sinox W) showed a reduction in stand of almost 50% at 2 pounds per acre but only a slight reduction at $\frac{1}{2}$ pound with good weed control at both rates. Sinox General gave good weed control in sesame, safflower, castor beans, perilla, and sunflower but damaged all the crops. Peas, various beans curcurbits and sunflower tolerated pre-emergence applications of a dinitro with good control of small-seeded weeds providing surface moisture was present.

LFN#472 at 1 pound and sodium pentachlorophenate at 4 and 12 pounds showed promise and gave good weed control. Sesame, sunflower and perilla were not affected by the pentachlorophenate at 4 pounds but perilla was affected by the 12 pound rate. Diesel oil gave no weed control and did not affect these crops. IPC gave fair weed control at 15 pounds per acre.

PROJECT V INVESTIGATION OF WEED CONTROL METHODS IN HORTICULTURAL AND TRUCK CROPS, POTATOES, SUGAR BEETS, LEGUMES, ETC.

Abstracts of Results of Individual Cooperators.

Legumes

29

Effect of 2,4-dichlorophenoxyacetic acid on soybeans. Owen, C. W. Applications of 2,4-D acid at two rates 1/8 and ¼ pound per acre of sodium salt, amine and propyl ester were made at two dates, emergence and one week later, on two soybean varieties A. K. (Harrow) and Harmann. The plots were three rows wide, 42 inches apart and 35 feet long. Two rows of each plot were sprayed. All plots were randomized and in triplicate. Planting was done on June 2, the first application of spray being made on June 14 and the second on June 23. Observations and ratings on weed growth and effect on soybeans were made on July 17. No noticeable difference in effects on varieties was observed. In all cases the applications made at time of emergence gave less control of broad-leaf weeds than the later applications also a less depressing effect on the soybeans. The least weed control and the least effect on soybeans was noted in the earlier application of amine at 1/8 pound rate. Sodium salt was intermediate to ester, which gave best weed control but also most severely effected the soybeans. No date or rate of application influenced grasses. Consequently the entire test, without cultivation, became a mass of grass and weeds by fall which made the obtaining of any yields a hopeless proposition. Under the conditions of the test the use of 2,4-D apparently has little or no place in soybean culture in replacing timely cultivation practices. (Contribution of Dominion Experimental Station, Harrow, Ontario; Experimental Farm Service; Dominion Dept. of Agriculture.)

30

Spraying soybeans with 2,4-D. Slife, F. W. and R. F. Fuelleman. Post-emergent treatment at the rate of 1/4 pound acid in the salt and amine forms were applied to Richland soybeans, four inches in height. Severe twisting, lodging and curling followed. After two weeks, growth was resumed, and treated plots matured about 1 week later than untreated plots. Yields on these plots were approximately 75 percent of untreated soybeans. Other plots were treated with 1/4, 1/2 and one pound of amine when the soybeans were 24 inches high; severe twisting of plants occurred on all plots. Plots treated with one-fourth pound applications yielded about 50 percent of check plots; 1/2 pound rates gave no measurable yields and one pound rates killed all beans. (Contribution of Ill. Agr. Exp. Sta.)

31
The effect of 2,4-D on soybeans at Columbus, Ohio. Shaw, Warren C. and C. J. Willard. Lincoln soybeans were drilled solid May 26, 1948. The experiment was a randomized block design of three replications. Plot size 10' x 20'. The butyl ester and triethanol amine salt of 2,4-D were applied as a post-emergence spray at 1/48, 1/24, 1/12, 1/4 and 1/2 pound acid equivalent per acre at the cotyledon stage (June 1), first two true leaves (June 10), first trifoliate leaf (June 19), and first flower stage (July 26). Any rate of 2,4-D which gave satisfactory weed control also produced serious injury to the soybeans at all stages of treatment. No desirable growth stimulation resulted from either formulation of 2,4-D at any rate, or any stage of treatment. No desirable growth stimulation resulted from either formulation of 2,4-D at any rate, or any stage of treatment. The butyl ester was a great deal more active than the amino salt at 1/48, 1/24 and 1/12 pound acid equivalent rates. At the 1/4 and 1/2 pound level the difference in response of soybeans to the two chemicals was not too great. Soybeans appeared to be most resistant to 2,4-D at the cotyledon stage and the flowering stage. 1/4 and 1/12 pound applied at the first trifoliate leaf stage delayed maturity for about 5 to 7 days.. Contribution of the Ohio Agr. Exp. Station.

32
The effects of 2,4-D and TCA on the yields of nine soybean varieties and on the weeds in the soybeans. Derscheid, Lyle A. and D. E. Kratochvil. Duplicate 16-foot 2-row plots with 3.5- ft.spacing of Capital, Hawkeye, Lincoln, Manchukota, Richland, Ottawa Mandarin, Flambeau, Earlyana, and Bavender Special, a farmer selection, were treated with rates of $\frac{1}{4}$ and $\frac{1}{2}$ pound of 2,4-D acid per acre in triethanol amine form and with rates of 6 and 16 pounds TCA acid per acre in ammonium salt form when beans had 6 leaves and were 6 to 8 inches tall. Lamb's quarters (Chenapodium album), rough pigweed (Amaranthus retroflexus), Kochia (Kochia scoparia), common ragweed (Ambrosia artemisiaefolia), foxtails (Setaria viridis and glauca) and barnyard grass (Echinochloa Crus-galli) were 4 to 6 inches tall. All plots were cultivated three times and the rows were hand-weeded when beans were 12-16 inches tall at which time weed counts were made and amount of control determined. TCA did not control the grasses, but both rates of 2,4-D controlled 50-75% of the broad-leaved weeds. 2,4-D stunted the soybeans so badly that grassy weeds outgrew the soybeans. An analysis of variance indicates that yields were changed due to treatment and an L.S.D. indicates that all treated plots produced yields that were significantly lower than those of untreated plots. The interaction "treatments x varieties" produced an "F" value that was significant as 5% level indicating that all varieties did not respond the same and an L.S.D. indicates that the yields of Lincoln, Manchukota, and Bavender Special were not decreased by the application of $\frac{1}{4}$ pound of 2,4-D acid per acre; whereas, all other treatments decreased the yield. The maturity of soybeans treated with 2, 4-D was delayed two weeks while the TCA caused more delay. If frost had been received as early as usual none of the treated plots would have matured. This study indicates that it is hazardous to use 2,4-D or TCA as post-emergence treatments on soybeans when the beans are 6 to 8 inches tall. (Contribution by the Agronomy Department of the S. Dak. Agr. Exp. Station)

33
Effect of three herbicides on soybeans. Helgeson, E. A. and C. R. Swanson. Soybeans were treated at the time of emergence, June 17, with a butyl ester of 2,4-D at 1, 2 and 4# per acre, the ammonium salt of trichloroacetic acid (TCA) at 25, 50 and 100 # per acre, and a dinitro (Sinox W) at the rate of ½, 1, and 2# per acre. At 1#, 2,4-D the stand was reduced approximately 25%, at 2# the stand was less than half that of the control, and at 4# only a few plants survived. The action of TCA was quite severe but stands were not reduced as greatly as on plots treated with 2,4-D. At 25# per acre TCA caused wrinkling and brittleness of the cotyledons and first leaves. At 50# this effect was somewhat greater and at 100# the first true leaves were greatly dwarfed, yellowed and brittle. Most grass weeds were well controlled by TCA. Soybeans treated with ½# per acre of Sinox W at time of emergence appeared unaffected by the treatment and most grass and broadleaf weeds were well controlled. The stand of soybeans treated with 1# of Sinox W per acre was reduced slightly and that of the 2# treatment was reduced almost 50%. There was good weed control in both cases. The control plot was infested with pigweed, common ragweed, and green pigeongrass. No yield data were taken. (Contribution of N. D. Agri. Exp. Station and Div. of Cereal Crops and Diseases, BPISAE, U. S. Dept. of Agri.)

34
Spraying a seed field of Ladino clover with 2,4-D. Van Fossen, J. E. About May 1, 1948 we sprayed a patch of Canada thistles in a 30-acre meadow that was a thick stand of Ladino clover with a light stand of medium red clover. The thistles were killed and the red clover was killed but the Ladino recovered until it looked like the best spot in the field. This field was heavily infested with broad-leaf plantain and curled dock. The field was clipped June 10 and by July 1 the weeds were too thick to use the field for seed. We sprayed the entire 30-acre field with 1/4 pound acid equivalent of butyl ester of 2,4-D per acre and killed the broad-leaf plantain and the dock, bull thistles and all of the red clover. The Ladino was set back about the same as if it had been clipped but recovered nicely and resulted in a clean stand of Ladino clover that set plenty of seed. About half of this field was mowed and raked for seed but was not threshed because of rainy weather. There was an excellent prospect for clean Ladino seed from a very filthy field. J. E. Van Fossen & Sons, Croton, Ohio.

35
Spraying legume crops with 2,4-D. Slife, F. W., R. F. Fuelleman. Second year red clover was sprayed February 16, March 20, April 17, and June 30, with ester and sodium salt formulations. The purpose of this experiment was to try to eliminate narrow leaf plantain or buckhorn and not effect established clover stands too seriously. The results indicate that any concentration of 2,4-D that will kill buckhorn will severely injure or destroy red clover. The selective material, dinitro, was ineffective in destroying or preventing seeding production of buckhorn at rates that would not severely effect the red clover. One pound of acid in the amine form was applied to Ladino clover in August. After one week a slight curling effect on the leaves was noticeable. Subsequent observation showed no serious after effect of 2,4-D. (Contri. of Ill. Agr. Exp. Sta.)

36
Spraying soybeans with T.C.A. Slife, F. W. and R. F. Fuelleman. Trichloroacetate was applied to Richland soybeans at rates of 5, 10 and 50 pounds per acre. The soybeans were 24 inches tall and were infested heavily with grass weeds, mostly foxtail (Setaria sp.). Soybean plants in all plots were severely affected. At the 5 pound rates the leaves remained curled throughout the growing season but pods were formed, although for the most part they were not filled. At the 10 pound rates, no pods formed and the leaves were severely curled. At the 50 pound rates, all the leaves dropped off one week after application. The two lighter rates had little effect on the grass weeds, but at the 50 pound rate, a fair measure of control was obtained. (Contribution of Ill. Agr. Exp. Sta.)

37
Effect of pre-emergence sprays with two formulations of 2,4-D on garden peas. Andersen, E. T. and A. B. Mantell. The butyl ester and sodium salt of 2,4-D at rates of 0.25, 0.50 and 1.0 pound (pure acid equivalent) per acre, were applied in spray form to Little Marvel peas. Applications were made two days after seeding, and just before emergence of the crop. Analysis of yield data (pod weight) indicated statistically significant reduction in yields from both formulations with the 0.50 and 1.0 pound rates applied at the first date. This reduction was greatest at the 1.0 pound rate. A similar trend, although not significant, was evident from applications made at the second date. The reduction in yields resulted primarily from reduced pea emergence and stand, rather than from actual plant distortion. Plants showing distortion appeared to recover early in the season. (Contri. of Division of Plant Science, University of Manitoba, Winnipeg)

38
Residual pre-emergence weed control with phenolic herbicides. Barrons, K. C., Mullison, W. R. and Coulter, L. L. Large-seeded crops including corn, peas, various beans, cucurbits, and sunflower tolerated effective residual dosages of PCP and DNOSBP with control of small-seeded weeds providing surface moisture was present. Promising results were obtained with established asparagus treated before first emergence and after discing following final cutting. Depth protection is believed to be the basis of selectivity so other large-seeded and many vegetatively-propagated crops will probably tolerate such a treatment. Emulsifiable formulations of the parent phenols and water solutions of their salts proved successful. 15 to 25 lbs. of PCP or its sodium salt or 5 to 8 lbs. of DNOSBP or its ammonium salt per acre are suggested for trial. For row treatment one third these rates may be used. The preference for one compound over the other has yet to establish under various conditions and with different weeds. Some specificity of reaction between weeds and compounds was observed but to most species, DNOSBP is between 3 and 4 times as toxic as PCP. With quick-emerging crops applications at the time of planting which permits combining the two operations gave as good control as delayed treatment. If a salt formulation is used for delayed application miscible oil should be added to insure contact action on weeds that are already up. (Contri. of The Dow Chemical Co., South Haven, Michigan)

39
Pre-emergence treatments of chemurgic crops with eight herbicidal materials. Sand, Paul and N. E. Shafer. Soil applications of ammonium trichloroacetate at 25 and 50 lbs., LFN#472 at 1 and 2 lbs., isopropyl-N-phenyl carbamate at 7½ and 15 lbs., sodium trichloroacetate at 25 and 50 lbs., diesel fuel at 50 and 80 gallons, Sinox General at 1 and 2 lbs., sodium pentachlorophenate at 4 and 12 lbs., and 2,4-D at ½, 1 and 2 lbs. per acre were made June 7, 1948. All rates given are on the per acre basis. Crops treated sesame, safflower, castor beans, perilla and sunflower. One row of each crop was planted in plots 10 x 10 feet. Planting was done June 5, 1948. Precipitation following treatment amounted to .12 inches on the fourth day, .23 inches on the fifth day, and a total of 3.85 inches for the 30 days following treatment. Notes on emergence were taken 8 days after planting and on crop damage 5 weeks after planting. Chemicals which show promise and gave good weed control are LFN#472 at 1 lb. per acre and sodium pentachlorophenate at 4 and 12 lbs. per acre. Sesame, sunflower, castor beans, and perilla were not affected by LFN#472. Castor beans, sunflower, and perilla were not affected by sodium pentachlorophenate at 4 lbs.; however, perilla was affected at the 12 lb. rate. Crops considered seriously affected were badly stunted or burned and looked incapable of complete recovery. Of the other chemicals ammonium trichloroacetate and sodium trichloroacetate did not control weeds and affected all crops. Sinox General gave good weed control but damaged all crops. Diesel fuel gave no weed control and did not affect crops. IPC gave fair weed control at 15 lbs. per acre. 2,4-D showed good weed control at 1 and 2 lbs. but affected all crops to some extent, the results not being consistent. One half lb. of 2,4-D did not damage the crops but gave no weed control. (Contri. of Dept. of Agronomy, College of Agriculture, Lincoln, Neb.)

PROJECT V INVESTIGATION OF WEED CONTROL METHODS IN HORTICULTURAL AND TRUCK CROPS, POTATOES, SUGAR BEETS, LEGUMES, ETC.

Abstracts of Results of Individual Cooperators.

Sugar Beets

40

Pre-emergence weed control in sugar beets. Young, H. C., W. E. Hall, C. J. Willard, Clyde Wilson, and H. R. Bruner. The main test consisted of the following formulations applied per acre: aromatic oil at 12½, 25 and 50 gal. per acre; aromatic oil fortified with 10% pentachlorophenol and an emulsifier at 2½, 5 and 10 gal; aromatic oil fortified with 5% 2,4-dinitro secondary butyl phenol and an emulsifier at 2½, 5 and 10 gal. All formulations were diluted to 50 gal. and replicated 3 times. They were applied immediately following the seeding of the beets at 3 planting periods, namely, early, medium and late. The season was below average in temperature and rainfall and weed population not too heavy until June. Satisfactory control of weeds was obtained with the 2nd and 3rd concentrations of each formulation. However, injury to the beets was obtained with all the oil and dinitro treatments that were strong enough to control weeds. Pentachlorophenol in aromatic oil controlled weeds at the 5-gal. dosage, but gave a slight reduction in stands at the 10-gal. dosage. A timing and dilution series was set up with these same formulations. Treatments were made 2 and 4 days before beet emergence with 1 ¼, 2½ and 5 gal. of aromatic oil fortified with 1¼, 2½ and 5% pentachlorophenol and dinitros respectively. The results indicated again that with pentachlorophenol a margin of safety and effective control of weeds existed. The control extended over a rather long period. It was possible to mechanically block and thin the beets in the pentachlorophenol plots without hand labor. Another series consisted of treatments with relatively new formulations, such as Dow Selective, Dowicide G., Nix, PEC, MACC, Sulfasan, Santobrite, Tetrachlorophenol, and TCA. (Ohio Agr. Exp. Sta., Wooster, Ohio).

41

Effect of pre-emergence sprays with 2,4-D and oils on sugar beets. Andersen, E. T. and A. B. Mantell. The following treatments were applied in spray form to sugar beets: ethyl ester and sodium salt of 2,4-D, each at rates of 0.25, 0.50 and 1.0 pounds (pure acid equivalent) per acre; Shellsol (oil weed killer, prepared by the Shell Oil Co.) at 60 gallons per acre; two emulsions of diesel fuel in water at proportions of 1 part oil:1 part water, and 1 part oil:4 parts water, applied at the rate of 80 gallons per acre. Applications were made 2 days after seeding and just before emergence. Due to unfavourable growing conditions, weed growth at the time of spraying was insignificant. About one month after treatment, no differences in weed growth could be detected, so weeds were removed. Analysis of yield data (root weight) indicated no significant reduction in yields with any of the treatments applied at either date. Shape and size of beets were likewise not affected. (Contribution of Division of Plant Science, University of Manitoba.)

42
Summary of weed control investigations in sugar beets at Fargo, N. Dak. and East Grand Forks, Minn. conducted during the summer, 1948. Pre-emergence treatments. Swanson, C. R., E. A. Helgeson, L. M. Stahler. Sinox General applied at 1, 2 and 4#/acre with good weed control at East Grand Forks and originally at Fargo but weeds came in later. Sinox W applied at 1, 2 and 4#/acre with similar results at East Grand Forks but only mustard controlled at Fargo. ACX-170 and ACX-184 applied at 50 and 100 gal./acre. 50% weed and beet stand reduction at 100 gallons of ACX-170. 50% beet stand reduction at 100 gallons ACX-184 with no grass control but some control of broadleaf weeds at both rates. Trichloroacetic acid, ammonium and sodium salts (TCA), applied at 6, 12, 24, 48 and 96#/acre. Sugar beet stand decreased with increasing concentration of chemical with a 50% reduction in beet stand at the highest rate. Weedy grasses controlled well at the higher rates and severely stunted at lower rates. Little noticeable effect on subsequent development of beets as evidenced by normal weights of 15-beet samples and normal sugar content. 2,4-dichlorophenoxyacetic acid, sodium salt, (2,4-D) applied at 1, 2 and 4#/acre. Beets virtually eliminated and all weeds except smartweed and grasses controlled well. Calcium cyanamid applied at 75, 100 and 150#/acre. Sodium pentachlorophenate applied at 4, 8 and 12#/acre and I.P.C. applied at 2,4 and 8#/acre. No weed control or injury to sugar beets for these three chemicals. (Contr. of Div. of Cereal Crops and Dis., BPISAE, U. S. Dept. of Agri. and N. D. Agr. Exp. Sta.)

43
Summary of weed control investigations in sugar beets at Fargo, N. D. and East Grand Forks, Minn. conducted during the summer, 1948. Post-emergence treatments. Swanson, C. R., E. A. Helgeson, L. M. Stahler. ACX-184 applied at 16, 32 and 64 gal./acre. There was more injury to beets when sprayed immediately after blocking than when sprayed 3 weeks later. Injury to beets ranged from 30% kill at 16 gal./acre to 65% kill at 64 gal./acre. There was no control of grassy weeds. Weights of 15-beet samples were inconsistent and sugar content decreased slightly with increasing rate of application. ACX-170 applied at 16, 32 and 64 gal./acre. Injury to beets was more severe than with ACX-184 ranging from 60 to 100% kill from low to high application. Grasses were stunted at the two lower rates and killed at the highest rate. Sample weights decreased markedly with increasing rate of application but sugar content was unaffected. NaCl and KCl applied at 40, 80 and 160 gallons saturated solution/acre. No weed control and little injury to beets. For NaCl sample weights were highest on plots treated immediately after blocking and at the rate of 160 gal./acre. Sample weights for KCl-treated plots and sugar content for both chemicals did not vary greatly from controls. Trichloroacetic acid, ammonium and sodium salts, (TCA) applied at 4, 6, 8 and 16#/acre. Chlorosis and pinching of beet leaves with some stunting of grass of higher rates. Sample weights and sugar content slightly lower than controls. Fortified oils (ACX-262, 263, 264, 265) applied at 16, 32 and 64 gal./acre. Grass weeds injured at low concentrations and killed at highest. Beets were killed rapidly. Sample weights and sugar content decreased with increase in chlorophenol content. (Contr. of Div. of Cereal Crops and Dis., BPISAE, U. S. Dept. of Agri., and N. D. Agr. Exp. Sta.)

Summary of Regional Studies on: E. A. Helgeson, Leader

Sugar Beets

I. Pre-emergence. The sodium salt and ethyl ester of 2,4-D were applied as pre-emergence sprays at rates ranging from ¼ to 4 pounds acid equivalent per acre. In one case with the maximum application being 1 pound there were no effects on weeds and no significant reduction in yields. In another case application of 1 pound per acre resulted in an insignificant stand of badly misshapen beets and elimination of most broadleaf annual weeds.

Reports on ammonium and sodium trichloroacetate (TCA) from but one station applied at 6, 12, 24, 48 and 96 pounds per acre on 3 dates before emergence indicate considerable reduction in stand at higher rates but normal sample weight and sugar content. Grass weeds (Setaria spp.) were controlled at higher rates and severely stunted at lower rates.

Aromatic oils and oils fortified with 10% pentachlorophenol and 5% dinitros respectively were applied at rates ranging from 2½ to 100 gallons per acre. Satisfactory weed control was obtained with 5 and 10 gallons of fortified oils but there was injury to beets. Aromatic oils at 50 and 100 gallons per acre showed some weed control but an equal injury to sugar beets. 1¼ to 5 gal. applications of aromatic oils fortified with 1½ to 5% pentachlorophenol resulted in effective weed control and no injury to sugar beets. Diesel oil emulsions in water, 1 to 1 and 1 to 4 applied before emergence did not decrease beet yields nor control weeds.

Sample weights of plots sprayed with dinitros in water and in oil and water at 1, 2 and 4 pounds per acre were decreased but stands were not affected. Sugar content was normal with no differences in rates or dates of application. There was some degree of weed control.

Calcium cyanamid at 75 to 150 pounds per acre, sodium pentachlorophenate at 4 to 12 pounds per acre, and IPC at 2 to 8 pounds per acre showed no weed control and no injury to sugar beets. These plots were not harvested.

II. Post-emergence. Results on post-emergence studies are available from one station only. The herbicides used were applied just after blocking, three weeks after blocking, and six weeks after blocking. Aromatic oils were excessively injurious to beets at rates which would control weeds. Oils fortified with several concentrations of pentachlorophenol caused almost immediate killing of sugar-beets at even the lowest rate of 16 gallons per acre. Sugar content and sample weights decreased with increase in rate of application.

Sodium and ammonium TCA applied at 4 to 16 pounds per acre did not control grass weeds and caused yellowing and pinching of sugar-beet leaves. Weights of 15-beet samples were lower than controls,

Sugar Beets (Summary continued)

and sugar percentages were slightly lower than controls.

Sodium and potassium chlorides were applied at 40 to 160 gallons of saturated solution per acre with no weed control and little injury to sugar beets at any concentration. For NaCl, sample weights were highest on plots treated immediately after blocking and at the 160 gallon rate. Sugar content did not vary greatly from controls for either chemical.

PROJECT V INVESTIGATION OF WEED CONTROL METHODS IN HORTICULTURAL AND TRUCK CROPS, POTATOES, SUGAR BEETS, LEGUMES, ETC.

Abstracts of Results of Individual Cooperators.

Potatoes

44
Pre-emergence weed control in potatoes. Bruner, H. E. Plots of Irish Cobbler and Katahdin potatoes were treated with 20 lbs. of Santobrite applied in 100 gallons of water per acre. The application was made as the potatoes were emerging (about 5% showing) with an air blast fruit type of sprayer. Abundant weeds, consisting of smart weed, small and giant red root, purslane, giant ragweed, sunflower, and Spanish needle, were all controlled except the giant smartweed. This experiment was conducted on low overflow muck land and contained an abundance of weeds. (Monsanto Chemical Co., Akron, Ohio)

45
Pre-emergence weed control in vegetables. Wilson, J. D., H. E. Bruner, and W. E. Hall. At least 16 of 19 formulations, mostly with pentachlorophenol, dinitros, and 2,4-D, applied to potatoes just as the first plants were coming up (May 12) gave good control of weeds (chiefly smartweed) and this control persisted for several weeks in most instances. Sodium pentachlorophenate in water and 2,4-dinitro secondary butyl phenol in aromatic oil were slightly injurious to the potatoes but gave excellent weed control. 2,4-D as the sodium salt and the amine checked weeds effectively, but at the same time caused severe leaf deformation, so severe that no normal leaves were produced for 6 weeks. Eight to 12 vegetables were planted in adjacent rows in duplicated plots and sprayed crosswise with 18 to 20 weed-killing formulations just before emergence in experiments started on three different dates. Corn was found to be best able to survive all of the hazards involved in this type of treatment. Snap beans and cucumbers ranked second and third, respectively, in survival power. All three of these possess comparatively large seeds. Tomato, cabbage, carrot, and lettuce were very sensitive to injury in most instances. Again the dinitro compounds in oil, sodium pentachlorophenate in water and various forms of 2,4-D were most injurious to the vegetables but gave good weed control. The best balance between weed control (smartweed, purslane, red root, and shepherd's purse) and vegetable survival was obtained with various formulations of either pentachlorophenol or Sulfasan (Xanthogen disulfide) in an aromatic oil. (Agric. Exp. Sta., Wooster, Ohio)

46
Effect of various systemic (hormone) herbicides on potatoes and weeds. Pavlychenko, Thomas K. A strip of potatoes 4 rows wide and 120 ft. long was treated in duplicate when the crop was 8 inches high with 2, 4 and 8 ounces acid eq/a, of Weedone concentrate 48; 8 oz/a of Weedone #5 (ethyl esters 2,4-D) 2 and 4 oz/a of Weedar 64 (amine salt 2,4-D), LFN 472 (2,4-D acid), 95% monohydrate sodium salt and Weed-No-More (butyl ester, 2,4-D). No further weeding or cultivation was done on these plots until maturity. The second similar series of plots received no chemical or cultivation treatments from planting till maturity. The third series received no chemical treatments, but the crop was hilled. Results: In series one, the susceptible weeds were effectively controlled. Russian thistle (Salsola kali) was very seriously stunted and mostly prevented from seeding by 4 oz/a, considerably reduced in size by 2 oz/a rates. Lambsquarters (Chenopodium album) gradually died in most cases. Wild buckwheat (Polygonum convolvulus) and redroot pigweed (Amaranthus retroflexus) were present in small numbers and showed a considerable resistance. The yield of potatoes was very low due to drought. However, it was rather consistently higher in the untreated, hilled series, followed

Summary of Regional Studies on: E. A. Helgeson, Leader

Potatoes

The number of abstracts received on potatoes was too limited to furnish any positive proof of the value of herbicidal treatments with this crop. Used as a pre-emergence treatment at rates up to 4 lbs./acre various formulations of 2,4-D gave some indication of practical weed control with no reduction in yield. Pentachlorophenol and dinitros appeared fairly promising for pre-emergence weed control, although there was some slight top deformation in several instances. No yields were indicated. The one report on TCA as a pre-emergence application showed severe crop injury at rates from 25 to 100 lbs./acre with fair to excellent grass weed control as rates increased, while broadleaved weeds were not completely eliminated. No yields were reported but judging from field observations, reductions would range from 75% for the 25 lb. treatment to 90% at 100 lbs. Post-emergence treatments with various formulations of 2,4-D at rates from 2 oz. to 1 lb./acre indicated satisfactory control of susceptible weeds and no reduction in yield. In most instances, there was slight to severe stunting of tops, with esters showing the most severe deformation.

by the chemically treated but not hilled series, with the untreated and not hilled plots giving the lowest yield. The percentage of commercial size tubers was low in all plots, again due to drought. The main value of the test lies in the fact that the crop successfully resisted all the chemicals used. Only 4 and 8 oz/a rates of esters produced considerable curling of leaves but no permanent killing. Cutin on the foliage was destroyed by most chemicals resulting in a dark green color. (Contribution of Agric. Field Res., Amer. Chem. Paint Co., Ambler, Pa.)

47

Effect of 2,4-D on tuber set of two varieties of potatoes. Viehmeyer, Glenn. In an exploratory experiment 1/6 pound of 2,4-D per acre applied as a spray and in the form of Butyl ester to potato plants six to eight inches tall gave an increase in the number of tubers set per plant.

Two varieties, Nebraska No. 2 and Cobbler were included in the trial.

Treated plants showed typical 2,4-D curvatures for a few days following treatment as well as an apparent reduction of chlorophyll. New leaves produced after treatment were reduced in size and thickened and twisted.

At digging time it was found that the number of tubers set per plant had increases in the case of the Cobbler variety by 75% and in the case of Nebraska No. 2 by 54%. Yield of Cobbler was reduced by 2.5% while that of Nebraska No. 2 was increased by 31%.

The information offered above is from a purely exploratory experiment and should be considered as such. (Contribution Univ. of Nebr. Substa. North Platte, Nebr.)

48

The effect of various pre- and post-emergence applications of 2,4-D salt and ester formulations on the grade and yield of three potato varieties, Columbus, Ohio. Alban, E. K., Leslie McCombs, and Homer Swingle. During the 1948 season, Katahdin, Irish Cobbler, and Russet Rural varieties of potatoes were planted (Brookston silt loam) in a randomized block arrangement with 14 treatments replicated four times. The alkyl ester and sodium salt of 1.0 and 2.0 lbs., acid equiv. in 20 gallons of water per acre, were applied 4 and 14 days after planting as pre-emergence treatments. Post-emergence applications of 0.165 and 0.33 of the alkyl ester and 0.25 and 0.50 lbs. of the sodium salt were made when the potatoes were 6" to 8" high. Two check or untreated, replicated plots were also included. All plots were hoed as needed and cultivated 48 days after planting. Regular cultivation as required as continued through the season. The most effective weed control was obtained with the 2,4-D treatments ~~14~~ days after planting. Post-emergence treatments did not give adequate weed control and the ester formulations resulted in some damage, particularly to the variety Russet Rural. However, there were no statistically significant differences in total yield or grade of the harvested tubers, as related to 2,4-D treatments. (Contrib. of Dept. of Horticulture, Ohio Agr. Exp. Sta.)

49
Pre-emergence and post-emergence treatments with 2,4-D on potatoes in peat soil. Hernandez, T. P. A replicated experiment was conducted on peat soil in 1948 with Chippewa potatoes using pre-emergence and post-emergence treatments of a sodium salt containing 80.5% of 2,4-D. Two and 4 pounds of 2,4-D acid equivalent were applied as pre-emergence treatments on May 31 just before the potatoes emerged. Post-emergence treatments of ½ pound and 1 pound of 2,4-D per acre were applied on June 16 when the potatoes were approximately 6 inches tall. Also the same two rates were applied on July 7 when some potato plants were beginning to bloom. Another post-emergence treatment of 1 pound of 2,4-D per acre was applied on August 10 when the potatoes were fully grown and some tubers were over 2 inches in diameter. Weeds were removed by hand from all plots before large enough to cause competition with the potatoes. Good control of pigweed (Amaranthus retroflexus) resulted from the pre-emergence treatments of May 31 and post-emergence treatments of June 16. No significant reduction in yield resulted from any of the 2,4-D treatments. The post-emergence treatments of June 16 and July 7 severely stunted the potatoes. The first symptoms of 2,4-D injury were an erect appearance of the stems, petioles and leaves followed by an upward curling of the latter. The young developing leaves and wing-like margins were completely stunted but later growth appeared normal. The post-emergence spray of August 10 caused less apparent injury to the potato plants than the sprays applied at younger stages of growth. (Contribution of Dept. of Horticulture, Univ. of Wisconsin, Madison, Wis.)

50
Effect of pre-emergence sprays with two formulations of 2,4-D on potatoes. Andersen, E. T. and A. B. Mantell. The butyl ester and sodium salt of 2,4-D at rates of 0.25, 0.50, 1.0 and 2.0 pounds (pure acid equivalent) per acre were applied in spray form to Irish Cobbler potatoes. Applications were made at three dates: just after planting, 6 days after planting, and 5 days before emergence of the crop. Although no weeds were present at the time of spraying, slight weed control was evident after the potatoes emerged. Only very slight distortion of potato stems could be noticed. Analysis of yield data (tuber weight) indicated no statistically significant reduction in yields with any of the treatments applied at either date. (Contribution of Division of Plt. Science, Univ. of Manitoba, Winnipeg.)

51
Pre-emergence weed control in potatoes. Helgeson, E. A. and C. R. Swanson. A plot of Triumph potatoes was treated with butyl ester of 2,4-D at rates of 1, 2, and 4 lbs. acid equivalent, Sinox W at ½, 1 and 2 lbs., and ammonium TCA at 25, 50 and 100 lbs. per acre five days after planting. With 2,4-D broadleaf weeds (mainly Frenchweed, pigweed and lamb's quarters) were well controlled at all rates with fair grass weed (pigeon grass) control at 4 lbs. No marked injury to potatoes. Sinox controlled all weeds satisfactorily at 2 lbs./acre with good control at 1 lb./acre and fair at ½ lb./acre. Potatoes showed no ill effects. TCA gave good grass weed control at all rates. At 100 and 50 lb. rates potatoes were practically eliminated and only a few survived the 25 lb. treatment. (Contri. N. D. Agric. Exp. Sta. and Div. of Cereal Crops and Dis., BPISAE, U. S. Dept. of Agri.)

RESUME OF 1948 PROGRESS MADE IN RESEARCH ON ERADICATION OF WOODY PLANTS

During the past year there has been a decided increase in interest in the eradication of undesirable woody plants. This is manifested by the large number of inquiries the chairman of this subcommittee received from all over the United States and Canada. There have been many requests for the 1947 abstracts and "host reaction to 2,4-D" table. In addition, some states have prepared circulars on the control of woody plants along with herbaceous plants, and these have been widely distributed.

Encouraging progress was made during 1948 in research dealing with the eradication of woody plants. Among the outstanding results is the establishment of a more clearly defined pattern of the selective action of 2,4-dichlorophenoxyacetic acid (2,4-D) on woody plants. In addition, 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) also was tested extensively, but more time is needed before too much credence can be given to the experimental data concerning this chemical. Ammonium sulfamate (amate) was again used in many tests and obviously still has a place as a herbicide in spite of its several limitations.

Most experimentation was made with foliage spray or cut-surface treatment methods. Some tests were made, however, by placing chemicals in gashes cut in trees. Amate was used successfully with this method of application on several species of trees, but the results from similar tests with 2,4-D were inconclusive.

Almost epochal was the establishment of a successful 2,4-D treatment of sage on the western ranges in 1948. One pound of 2,4-D (acid equivalent) sprayed from airplanes at a total cost of $2.00 per acre effectively controlled sand sage. The elimination of sagebrush encourages the growth of forage and greatly increases the cattle-carrying capacity of the ranges. Since there are many millions of acres of sage-covered land, the potential prospects for improving the productivity of the western range areas by eradicating sagebrush are almost unlimited.

Thousands of acres of rights-of-way, especially along power lines, were sprayed with 2,4-D, both experimentally and on a practical commercial basis, during 1948. A combination of 2,4-D and 2,4,5-T was used both as a foliage spray and on cut surfaces experimentally as well as for rights-of-way clearance. Sufficient time has not elapsed to thoroughly evaluate the results of these tests. In commenting on the results he has obtained, Mr. F. A. Ashbaugh of the West Penn Power Company, Pittsburgh, Pennsylvania, makes the following encouraging statement concerning the feasibility of chemical eradication of woody plants:

> During 1948, we commercially sprayed many acres of electric-line right-of-way. In addition, we made 125 separate plot tests of varying combinations of herbicides. The data I am furnishing you is therefore based on many thousands of observations.
>
> For your information, we now feel that we can control all the woody plants normally found on rights-of-way in western Pennsylvania by means of combinations of 2,4-D and 2,4,5-T esters, except the following: basswood, ash, beech.

The selectivity of herbicides such as that of 2,4-D is proving to be a useful tool in eliminating competitive useless shrubs and trees that impair the successful regeneration and growth of valuable forest trees. In the Great Lakes region 2,4-D appears to be very useful in keeping undesirable shrubs such as hazel brush and others under control. In addition, with 2,4,5-T and probably other chemicals showing some useful potentialities as selective herbicides, at least one major difficulty of successful reforestation perhaps will be eliminated.

Numerous reports were received regarding the effect of 2,4-D and 2,4,5-T on trees and shrubs that reduce the efficiency of permanent pastures in the Eastern States, but there was no indication that projects had been started to remove the brush and trees in order to improve the forage production in these pastures. A pasture-improvement program of this kind obviously would increase grazing capacity and reduce supplemental grain-feeding requirements.

No new methods of eradicating woody plants by mechanical means were reported, but observations made and reports received demonstrate that the mechanical eradication of sagebrush on the ranges, though expensive, has resulted in a decided increase of forage production. Previous results now are substantiated.

Along rights-of-way, large trees and coarse brush must be cut off. All information indicates that this eradication practice is being increasingly augmented by the application of concentrated herbicides to the freshly-cut surfaces to prevent sprouting. The reduction in the amount of regrowth from cut-surface treatment has been estimated to be in excess of 60 percent. This results in a tremendous decrease in the cost of right-of-way maintenance and is a good demonstration of the advantage of combining mechanical and chemical means of controlling woody plants.

To cite the progress made on all species of woody plants is impossible in this brief summary. Accordingly, only the results of the work done with five representative types of plants that are common in the North-Central States are cited as examples of the status of the available information on chemical methods of control.

Heretofore, buckbrush and snowberry (Symphoricarpos spp.) have appeared tolerant to 2,4-D foliage sprays. However, in the states of Oklahoma, Kansas, Illinois, Iowa, Manitoba, Saskatchewan, and others, it now appears that this type of shrub may be killed by spraying it in the succulent stages with higher concentrations of 2,4-D. Solutions--usually 2,000 p.p.m.--of esters of 2,4-D have been used most commonly. The newer herbicide--2,4,5-T-- also seems effective for killing this type shrub. There were no reports received as to the effect of conbining 2,4-D and 2,4,5-T into one spray on plants of this genus. It is suggested that this be tried in 1949.

All reports show that no further progress has been made in the search for a foliage spray of 2,4-D that will kill Osage Orange (Maclura pomifera). The reports of the effect of 2,4,5-T on this woody plant are conflicting, but there are indications that 2,4,5-T will kill under some conditions. One report shows that using a combination of 2,4-D and 2,4,5-T (3,000 p.p.m.) as a foliage spray kills Osage Orange in all stages of growth. This might imply that there could be a "synergistic" effect as a result of the combinations. Tests with this in mind should be conducted extensively in 1949.

Many of the species of the willow group (Salix spp.) now appear to be more easily killed with 2,4-D than has been indicated in the past. This is especially true with the use of higher concentrations (2,000 p.p.m. or more). A limited number of workers found that this group of plants also seems to be sensitive to 2,4,5-T. Here is another group on which extensive tests with the combination of 2,4-D and 2,4,5-T should be made.

Hawthorns (Crataegus spp.) also constitute a group of woody plants that are not readily killed with foliage sprays of 2,4-D. Since this is a complicated group from the taxonomic standpoint, there might be selectivity of 2,4-D for different species that the experimentor might not be able to detect. There are practically no data available on effects of 2,4,5-T on the plants of this genus. One report of the combination of 2,4-D and 2,4,5-T indicates that some plants could be killed when sprayed in the succulent stage. This is a persistent type of plant in permanent pastures and therefore warrants considerably more testing than has been done in the past.

Native and escaped blackberries, raspberries, and dewberries (Rubus spp.) are noxious spiny shrubs in many permanent pastures and wood lots. All of them appear tolerant to 2,4-D but a limited number of workers found that blackberries are sensitive to 2,4,5-T. Blackberries and black raspberries were sensitive to combination sprays of 2,4-D and 2,4,5-T. Dewberries seemed to be tolerant, However, the number of tests reported was too small to be significant. Further tests are urgently needed for this group of plants.

If reports were given on all woody plants, the data would further substantiate the fact that, while a good start has been made in finding simpler means of controlling woody plants, there obviously remains a need for extensive basic research and experimentation over a long period of years.

No reports on new effective herbicides more recent than the announcement of 2,4,5-T were received. Informal reports indicate there is extensive testing of concentrated low-volume, highly-atomized solutions of 2,4-D on woody plants. Some extensive tests were made with over four percent of 2,4-D in distillate applied as a fine spray. There also has been a general trend toward increased concentrations of 2,4-D--i.e., 2,000 p.p.m. or higher--but the use of distillate only as a solute is a departure from water diluents. However, few reports or abstracts were received concerning the results of the use of high concentrations in distillate oil. In airplane spraying with one pound of 2,4-D to five gallons of liquid, only distillate could have been used as a diluent, but four gallons of water plus one gallon of distillate was much cheaper and just as satisfactory. It also would appear that for a maximum effect of 2,4-D, when applied to cut surfaces, concentrations probably exceeding five percent are essential.

There is a need for additional research on spray nozzles. Some engineer should be assigned to study and assemble all of the available data on types of spray nozzles on the market. There also is much room for further research in improving spray equipment in general.

During recent years, the accomplishments in the research program dealing with the eradication of woody plants has been outstanding. However, years of continued team work such as exist in this organization will inevitably bring about the desired objectives for which we are striving.

Subcommittee on eradication of woody plants
L. W. Melander, Chairman

A B S T R A C T S

Submitted to
Subcommittee on Research
in Eradicating Woody Plants

North Central Weed Control Conference
1948

1

Comparison of 2,4-D, 2,4,5-T, and ammonium sulfamate applied to Osage orange. Klingman, Dayton L. On June 2, 1948, herbicidal sprays were applied to Osage orange hedge row, most of which was approximately 6 to 15 feet high in the small seed-ball stage of growth. Duplicate 50-foot plots were established in which the ethyl esters of 2,4-D and 2,4,5-T were applied in 160 gallons of water per acre at the following concentrations: 1000 p.p.m., 2000 p.p.m., and 12,000 p.p.m. The amine salt of 2,4-D was used at 4000 p.p.m. and ammonium sulfamate at 1½ pounds per gallon. Data are not conclusive since treatment was made and notes were taken this year; however, 2,4,5-T looks promising as a top killer, at least, for Osage orange. At 1000 p.p.m., the plots showed about 66% defoliation with considerable kill of top growth; at 2000 p.p.m. 90% defoliation with many branches and main leaders killed and at 12,000 p.p.m. 99% defoliation and most of the above ground portions killed. Resprouting at the base was more abundant at 2000 p.p.m. than at 1000 p.p.m. while at 12,000 p.p.m. resprouting was evident six weeks after treatment and the new shoots were 3 to 5 feet tall by October 2. Osage orange was resistant to 2,4-D, damage varying from practically nothing at 1000 p.p.m. of ester to 33% defoliation with 1 to 2 feet of branches killed at 12,000 p.p.m. 4000 p.p.m. of amine salt of 2,4-D gave results similar to 12,000 p.p.m. of ester. Ammonium sulfamate caused 66% defoliation immediately but the foliage was partially reproduced within 6 to 8 weeks. Observations October 2 indicated that branches were about 40% defoliated and dead back to 4 feet, with the remaining leaves somewhat chlorotic. Check plots were 2 to 3 feet taller than any treated plots. (Contribution of Division of Cereal Crops and Diseases, B.P.I.S.A.E., U.S. Department of Agricultura.)

2

Effect of 2,4-D on western snowberry (Symphoricarpos occidentalis.) Breakey, W. J. During 1948 two-acre strips were treated with two formulations and at two rates. The snowberry was sprayed June 3, a bright, warm day when growth was active. The machine used for spraying had a 30-foot boom and was attached to the tractor. Power was supplied by the pulley on the tractor, and pressure was maintained at 40 pounds. The two formulations used were amine and ester (butyl), each at two rates, 1 pound and 1½ pounds of acid per acre. The ester proved effective at both rates. However, the heavier rate proved more effective and gave a higher percentage of kill. Where the ground was even and the plants received uniform coverage of spray, at the 1½ pound rate of ester, approximately 100% kill resulted. The pound rate of ester gave a lower percentage of kill. Amine at both rates gave poor results and could not be considered an effective spray against western snowberry in these trials at these rates. Examination of plants in late October, treated with ester, showed the woody portion of the plants to be dried and hard, and when bent cracked easily and broke in two. When the woody portion

was pulled the root came away from the soil quite readily with every indication that the plants were killed. The leaves disappeared from the plants four weeks after spraying, and no further new growth was observed throughout the season. Further studies will be carried on in 1949, and a thorough examination will be made of the treated areas. (Contribution of the Dominion Experimental Station, Morden, Manitoba, Canada.)

3

Control of poison ivy with 2,4-D and 2,4,5-T. Slife, F. W. Ninety-five percent control of poison ivy has been observed with rates of 2 pounds of acid in the ester form and 4 pounds of acid in the amine form. Rates lower than this have given inconsistent results. Comparable rates of application of 2,4,5-T with 2,4-D ester indicated that 2,4,5-T was more effective in destroying poison ivy. (Contribution of Illinois Agricultural Experiment Station, Urbana, Illinois.)

4

Control of buckbrush with 2,4-D and 2,4,5-T. Slife, F. W. Buckbrush (Symphoricarpos orbiculatus) growing in pasture land has not been effectively controlled with rates below 2 pounds of ester and 4 pounds of amine preparation per acre. Ninety percent control has been obtained at those rates. Complete kills were observed at 4 pounds ester per acre. 2,4,5-T at 2 pounds per acre has given approximately 95 percent control. (Contribution of Illinois Agricultural Experiment Station, Urbana, Illinois.)

5

Eradicating snowberry (Symphoricarpos occidentalis) with 2,4-D. Breakey, W. J., H. E. Wood, and J. J. Bourns. This troublesome plant, especially in pastures, and commonly termed "buckbrush", has proven decidedly resistant to 2,4-D. In two series of trials 80 miles apart, one by knapsack on plots, the other by machine sprayer in two-acre blocks, excellent kills were obtained when treated in early spring (late May) 1948, when growth was active. An ester at 1½ pounds acid per acre gave almost 100 percent kill, whereas an amine at the same rate gave very poor results. On the plots a much better kill was obtained from the ester at 2 rather than 1 pound with water; the substitution of diesel oil gave almost 100 percent kill at 1 pound ester. (Contribution of Dominion Experimental Station, Morden, and the Weeds Commission, Manitoba, Department of Agriculture, Winnipeg, Canada.)

6

Eradicating woody growth with 2,4-D and 2,4,5-T. Wood, H. E., J. J. Bourns, and L. Playfair. Extensive test plots, supplemented by field trials and observations, indicated that many types of woody growth and weeds can be eradicated by spraying with 2,4-D and 2,4,5-T. A point some 90 miles west of Winnipeg was selected by the Manitoba Power Commission in the spring of 1948 on its right-of-way, where a dense regrowth of mixed woody plants, weeds and other herbaceous plant growth had been re-established after having been cut over two years previously. Butyl ester, isopropyl ester, and 2,4,5-T were used respectively at 4, 2, and 1 lb. acid per acre on half square-rod plots treated June 1, July 1, and August 1. Water sprays were used throughout, but on the second date an additional series of plots were treated, in which 5 percent of diesel oil was added to the water. Final observations made September 29 led to the following conclusions:

1. Excellent kills were obtained on all plots other than woody growth resistant to the chemicals used. (Glaucous willow, partially resistant; dogwood, nearly resistant;

gooseberry and buckthorn, resistant.)

2. There appeared little difference between the formulation used (2,4,5-T showed no superiority over 2,4-D), between the rates of application or the dates of treatment.

3. The addition of oil speeded up the action of the chemicals.

4. Nearby, ester and amine applied by power sprayer were compared; the former gave decidedly better kills on white poplar, whereas both were satisfactory on willows other than the glaucous.

5. Observations over two years on many miles of ditches and roadways on which various types of sprayers were used indicate 2,4-D as being effective in eradicating most kinds of woody growth; the turbine machine has proven very satisfactory for applying the chemical. (Contribution of Woods Commission, Manitoba Department of Agriculture, cooperating with the Manitoba Power Commission, Winnipeg, Canada.)

7

Range improvement through sagebrush control with 2,4-D in the Southern Great Plains. McIlvain, E. H. and D. A. Savage. Brush eradication studies conducted by the U. S. Southern Great Plains Field Station at Woodward, Oklahoma, since 1937 have proved conclusively that removal of sand sagebrush from sandy rangeland is an extremely effective range improvement practice. Mowing of sand sagebrush on duplicate pastures in June 1941 and June 1942 increased vigor, production, and density of the grasses; and raised grazing capacity 45 percent, gain per head of yearling Hereford steers 14 percent, and gain per acre 78 percent. However, mechanical removal of brush is slow and costly. Airplane application of 2,4-D, when properly done, kills up to 80 percent of the sagebrush and severely weakens the remainder. The method is economical, rapid, and capable of yielding grazing results comparable or superior to mowing. Extensive tests conducted during the past three years on over 2,000 acres of land show that (1) one pound acid equivalent per acre of ester, amine or salt is sufficient, (2) slightly less than one pound of 2,4-D as an ester may be satisfactory, (3) a homemade preparation, consisting of one pound of pure 2,4-D acid, 0.5 pound of sodium carbonate, 4 gallons of water, and 1 gallon of diesel oil has proved to be cheap and effective, (4) one gallon of diesel oil per acre increases effectiveness of both ester and salt solutions, (5) the minimum solution is 3 gallons per acre when using esters and 5 for sodium salt, (6) cross-wind flight intervals not more than one and one-half times the width of the boom are most effective, and (7) the plants must be leafed out and making rapid growth in the spring--generally in the month of May--for best results. (Contribution of Div. Forage Crops, Bur. Plant Industry, Soils, and Agr. Eng., ARA, USDA, and Okla. Agr. Expt. Sta.)

8

Results of 2,4-D foliage spray on hazel brush (Corylus rostrata). Jensen, R. A. During late August of 1946 about two acres of brushy area were sprayed with 2,4-dichlorophenoxyacetic acid in a concentration of 1000 p.p.m. The chemical was applied with a power type sprayer at 200 pounds pressure. The area was resprayed in August 1947, with the same chemical and at the same concentration. A check made in September 1948, showed 136 old stems on 2 milacres, 7 still alive, and 118 suckers originating from the root except for 2 which originated just above the root crown. The new shoots averaged 6-8 inches in length. In the spring of 1948 the area was scalped

and planted with 2-2 jack pine and red pine, 4x5 spacing. The dead hazelnut stems did not interfere appreciably with the planting as they were dry and broke easily. Although the hazel brush was not completely killed, the vigor of the sprouts has been reduced. This indicates a possible means of getting a brushy area back into production by some method of planting. Whether or not the plantation will surpass or succumb to the brush only time can tell. (Contribution of the Cloquet Experimental Forest, Division of Forestry, University of Minnesota.)

9

2,4-D applied to cut surfaces of Chinese elm, hackberry, and wild grape. Viehmeyer, Glenn. In late June a 9.6 percent formulation of ethyl ester of 2,4-D was brushed on the freshly-cut stumps of seedling Chinese elm (U. pumila), hackberry (C. occidentalis), and wild grape (Vitis vulpina), growing in the ornamental plantings at the station. Chinese elm was controlled by a single application in most cases with an occasional plant showing weak regrowth. Hackberry appeared tolerant with most of the plants recovering. Wild grape was completely killed. (Contribution of Assistant in Horticulture, North Platte Substation, University of Nebraska.)

10

Killing woody and herbaceous vegetation in preparation for forest planting on brushy areas. Zehngraff, P. J. Herbicides 2,4-D and Ammonium Sulphamate (Ammate) were used in three concentrations. 2,4-D (83.5%, salt) was used at the rates of 2½, 5, and 7½ pounds per acre, and Ammate at 50, 125, and 200 pounds per acre. All were mixed with water and applied at the rate of 300 gallons per acre. The chemicals were applied during two periods, namely early in June and late in July, 1947. Preliminary examinations at the end of the first growing season showed reasonable kill with all concentrations. Order of susceptibility to 2,4-D appeared to be: Corylus sp., Salix sp., Amelanchier sp., Populus sp., Alnus, Rosa, Rubus, Quercus sp., and Pteridium sp. Ammate appeared to be less selective, particularly at the higher concentrations. Final examinations at the end of the second growing season showed the same trend, but a considerably higher kill for all species in all concentrations. This examination, however, showed heavy resprouting. Resprouting was considerably less in all 2,4-D concentrations than in the first two Ammate concentrations. Ammate at the rate of 200 pounds, however, resulted in the least resprouting. The midsummer spraying resulted in considerably less resprouting than early summer spraying. (Contribution of Lake States Forest Experiment Station, U.S.D.A., University Farm, St. Paul, Minnesota.)

11

Release of red pine plantation from brush sprouts and herbaceous vegetation. Zehngraff, P. J. Herbicides 2,4-D and Ammate were applied during midsummer of 1947 as a spray on low brush sprouts and herbaceous vegetation which had come in over a newly established plantation of 2-1 red pine. The purpose was to obtain a partial killing, adding 25 to 50 percent light to the planted trees without injuring them. At the end of the first year examinations showed that one pound per acre of 2,4-D (83.5%, salt) killed some sprouts but little herbaceous growth. Two pounds killed most sprouts and caused injury to herbaceous growth. Three pounds killed all sprouts and heavily injured herbaceous growth. Little damage to the planted red pine was noted. Ammate at the rates of 10, 20, and 30 pounds per acre showed the same results, but also showed more damage to the planted pines. Examinations at the end of the second growing season showed good kill of brush under all concentrations, but no permanent effect on the herbaceous growth, and heavier injury to the planted trees following the use of Ammate than observed the first year. All concentrations were mixed with 30 gallons of water per acre.

Benefits of the added light to the planted trees are not yet noticeable. (Contribution of Lake States Forest Experiment Station, U.S.D.A., University Farm, St. Paul, Minnesota.)

12

Release of natural white pine reproduction from brush. Zehngraff, P. J. For this study was chosen a mature red pine stand in which regeneration cuts are to be started. The stand has an over-story of about 3,000 white pine seedlings per acre, overtopped by brush at the rate of 20,000 stems per acre. 2,4-D (83.5%, salt) was used at the rate of 4 pounds per acre, and Ammate at the rate of 80 pounds, both with water mixtures of 40, 80, and 120 gallons per acre. One set of plots was sprayed on September 1, 1947, the other on July 1, 1948. Examinations in September 1948 showed no resprouting following the use of 2,4-D during either of the seasons, but considerable resprouting following the use of Ammate. Use of 2,4-D on September 1 caused no injury to the pines, but slight injury followed the July 1 application. Use of Ammate caused heavy injury to the pines during both periods. The lowest mixture of water appeared slightly too low for complete leaf coverage and kill of brush; the highest water mixture caused the highest injury to the pines, apparently due to dripping. (Contribution of Lake States Forest Experiment Station, U.S.D.A., University Farm, St. Paul, Minnesota.)

13

Determination of minimum amounts per acre of herbicides for satisfactory brush kill. Zehngraff, P. J. Examinations of previous study plots indicated that most concentrations were unnecessarily heavy. A large study was initiated during the early part of July 1948 to determine minimum amounts of six chemicals for satisfactory kill of brush (90 percent hazel, Corylus sp.) at a density of 40,000 stems per acre, as follows:

Chemicals	Amount Per Acre			Water
	Lbs.	Lbs.	Lbs.	Gals.
2,4-D (83.5%, salt)	3/4	1½	2¼	80
2,4-5 (43%)	3/4	1½	2¼	80
Esterone 44 (44%, ester)	3/4	1½	2¼	80
ATA	3/4	1½	2¼	80
STA	3/4	1½	2¼	80
Ammate	10	25	40	80

Examinations at the end of the first growing season show satisfactory kill of hazel at the rate of 1½ pounds for the first three chemicals and at 25 pounds for Ammate. The other two chemicals appear slower acting and as yet killing is unsatisfactory at the highest level. It appears that the minimum requirements per 1,000 stems of hazel are:

Chemicals	Amounts[1/]
2,4-D	0.5 ounce
2,4-5	0.1 pint
Esterone 44	0.1 pint
Ammate	1.0 pound

1/ To be applied in 2 gallons of water.

(Contribution of Lake States Forest Experiment Station, U.S.D.A., University Farm, St. Paul, Minnesota.)

I4

Results of 1948 Tests to eradicate alder brush. Argonne Experimental Forest, Wisconsin. Stoeckeler, J. H. On July 16, 1948 an experiment to control alder brush was installed near Hiles, Wisconsin. The materials used were (a) Esteron 245 at a strength of 1 to 200 of water, using 96 gallons of spray per acre, and (b) Ammate applied to freshly-cut stumps with 21.3 lbs. of Ammate per acre, used at a strength of 2 lbs. per gallon of water. Counts made on August 24, 1948, showed a 93 percent reduction in number of stems for plots treated with Esteron 245 and 87 percent reduction in number of stems with Ammate, as compared with the original stand. The estimated cost per acre was $10.97 for Esteron 245 and $24.81 for Ammate. We rate alder as relatively easy to kill. (Contribution of Lake States Forest Experiment Station, University Farm, St. Paul, Minnesota.)

15

Effect of 2,4-D and 2,4,5-T in the control of woody plants. Friesen, H. A. During 1948 the amine and ester formulations of 2,4-D and the ester formulation of 2,4,5-T were applied as foliage sprays in dosages of ½, 1, 1½, 2, 3 and 4 pounds acid per acre to square-rod plots of silverberry (Eleagnus commutata), Western snowberry (Symphoricarpos occidentalis), and the prairie rose (Rosa pratincola). One application was made in midsummer. E. commutata appeared to be considerably more susceptible to 2,4-D than to 2,4,5-T. Complete defoliation resulted from all formulations and dosages of 2,4-D, but similar defoliation with 2,4,5-T required dosages in excess of 1½ pounds acid per acre. S. occidentalis was similarly more susceptible to 2,4-D than it was to 2,4,5-T. However, dosages of not less than 1 pound of 2,4-D and not less than 3 pounds of 2,4,5-T were required for complete defoliation. R. pratincola was very tolerant to all formulations of 2,4-D but was defoliated completely by all dosages of 2,4,5-T. None of the plots of R. pratincola treated with 2,4,5-T showed any signs of recovery in 1948. Plots of E. commutata and S. occidentalis treated with the butyl ester at rates of 2 and 3 pounds per acre in midsummer of 1947, did not recover in 1948. (Contribution of the Dominion Experimental Station, Scott, Sask.)

16

The effect of foliage sprays containing 2,4,5-trichlorophenoxyacetic acid applied at various intervals throughout the summer on poison ivy (Rhus toxicodendron). Davidson, J. H. During 1948 foliage sprays containing 2000 p.p.m. of 2,4,5-trichlorophenoxyacetic acid as the isopropyl ester were applied as a wetting spray to separate plots of R. toxicodendron under apple trees. Sprays were applied with a power sprayer at reduced pressures using a nozzle which gave a coarse fan type spray. Applications were made at two weeks intervals throughout the summer commencing June 16 and terminating August 25. All treatments gave complete kill of top growth the current season. No visible injury appeared on apple foliage. Final evaluation of the various treatments will be based on observations and regrowth in 1949. (Contribution of The Dow Chemical Co., South Haven, Mich.)

17

The effect of foliage sprays containing various 2,4-dichlorophenoxyacetic acid formulations on poison ivy (Rhus toxicodendron). Davidson, J. H. During 1948 foliage sprays containing 2000 p.p.m. of 2,4-D as the isopropyl ester, the amine salt and the sodium salt were applied as a wetting spray to separate plots of R. toxicodendron under apple trees. Sprays were applied with a power sprayer at reduced pressures using a nozzle which gave a coarse fan type spray. Applications were made at two weeks intervals throughout the summer commencing June 16 and terminating August 25. Regrowth and/or incomplete kill was apparent in all treatments made June 16. The most regrowth occurred in the sodium salt treatment. Later treatments showed complete kill from the ester but regrowth from the sodium and amine salt in

certain plots. This irregularity may be partially explained due to intra-species variation. No visible injury appeared on apple foliage. Final evaluation of the various treatments will be based on observations and regrowth in 1949. (Contribution of The Dow Chemical Co., South Haven, Mich.)

18

Suggested equipment and procedure for reducing injurious effects from 2,4-D and other herbicides when applied in close proximity to desired crops. Davidson, J. H. For the past three seasons successful applications of 2,4-D acid applied as the isopropyl ester, amine salt and sodium salt have been made for the control of poison ivy (Rhus toxicodendron) and horse nettle (Solanum carolinense) under apple trees. The sprays were applied with an orchard sprayer having a metal tank at a pressure of 200 pounds psi. A gun specially assembled for the purpose was used. This gun consisted of a quick-acting trigger shut-off, a suitable length of pipe to serve as a handle and a Chain Belt Rex Flat Spray nozzle. A gun thus equipped allows easy manipulation and control of the spray around trees and this type nozzle when used at low pressure produces a coarse fan type spray with very little mist at the edges. After spraying, the pump, tank and lines were cleaned by allowing lye at the rate of 13 oz. in 100 gallons water to dissolve in a full tank and stand several hours, then pumping the solution out thru pump and lines. Due caution should be exercised to drain the air chamber and bypass lines. (Contribution of The Dow Chemical Co., South Haven, Mich.)

19

Further tests on the control of woody plants by stump treatment with oil solutions of the esters of the phenoxyacetic acids. Barrons, Keith C. and L. L. Coulter. Tests pointing to the value of kerosene or fuel oil as carriers for the esters of 2,4-D for stump treatment were abstracted in the 1947 proceedings. Further tests indicate that many species may be controlled by this method at any time of the year. Variations in results appear to be related to factors other than season. Additional tests may show that some seasons are better than others with certain species. Tests of two volumes (light and heavy wetting) and two concentrations (4000 and 8000 p.p.m.) indicate that volume is equally as important as concentration. Although some species may respond better to a greater concentration 8000 p.p.m. is considered adequate for most situations. A liberal wetting of the cut surface and the surrounding bark should be given. Small brush remaining in a brushed-off area may often be killed by spraying the bark. In comparisons with the isopropyl ester of 2,4,5-T this compound appears more effective than 2,4-D on certain species. Pending further tests on species reaction to the two compounds a mixture of about 4000 p.p.m. of each is suggested for stump treatment. Because of lower solubility of the ester of 2,4,5-T at low temperatures finished sprays to be used in cold weather should be made up at room temperature. A single stump treatment often results in as great a reduction in regrowth as a single foliage application. This method may have a place where spraying hazards or lack of time prevent treatment during the growing season. (Contribution of The Dow Chemical Co., South Haven, Mich.)

20

Killing large willow stumps with 2,4-D. Coulter, L. L. Stumps of several large willows varying from three to five feet in diameter were sprayed with 10,000 p.p.m. and 30,000 p.p.m. of isopropyl ester of 2,4-D in No. 2 fuel oil. Applications were made May 19, 1948, and sucker buds were beginning to emerge at that time. The average amount of spray required to adequately cover each stump was .91 gal. In October 1948 suckers from stumps which were not treated had grown 10' - 15' high. Stumps sprayed with the lower concentration developed suckers 1' - 2' long with very thick stems and in some instances proliferated bark. These shoots, in most instances, all arose as a cluster

from one point on the stump. Suckers failed to develop on stumps sprayed with the higher (30,000 p.p.m.) concentration and disintegration of the cambial area followed by breaking of the bark has indicated that the stumps are completely dead. (Contribution of The Dow Chemical Co., South Haven, Mich.)

21

Effect of esters of 2,4-D and 2,4,5-T applied as foliage sprays and to cut surfaces of several species of woody plants. Zahnley, J. W., and G. L. McCall. Foliage applications were made at 1500 and 2000 p.p.m. on an acid basis of the esters of 2,4-D and 2,4,5-T. The esters were applied in water, in diesel oil and in 50-50 mixtures of the two. Applications were applied to cut surfaces at concentrations of 20 percent of the ester by volume in water and at 50 percent of the ester by volume in oil. All species tested with the exception of Osage hedge and buckbrush responded in approximately the same degree to 2,4-D and 2,4,5-T. Buckbrush was less affected by 2,4,5-T than by 2,4-D while Osage hedge gave greater response to 2,4,5-T than it did to 2,4-D. In general applications of the esters to freshly cut stumps were more effective than were the foliage sprays. (Contribution of the Kansas Agricultural Experiment Station.)

22

The chemical control of certain forest shrubs. Day, Maurice W. Tests of several formulations on a variety of forest shrubs are described. Foliage sprays, stem sprays, cut stump sprays and injection treatments were tried and a summary of results prepared listing the formulations, treatments and reactions for each species. Ammonium sulphamate proved to be most effective on hazel but other species sprouted strongly. The 2,4-D sprays were the most promising and were very effective on most of the species. Concentrated oil solutions gave much promise of preventing sprouting when applied as cut stump sprays. The dinitro-phenolic contact sprays resulted in strong resprouting but were effective as stem sprays on aspen and pin cherry. (Contribution of the Michigan Agricultural Experiment Station.)

23

Effect of esters and amine salts of 2,4-D when applied to cut surfaces of the canes of European barberry (Berberis vulgaris). Molander, L. W., and H. B. Busdicker. In 1947 we presented a preliminary report on the lethal effect of esters and amine salts of 2,4-dichlorophenoxyacetic acid when applied to the cut surfaces of canes of the European barberry (Berberis vulgaris). During the past year further tests have been made and satisfactory kills obtained in several states. During the winter of 1947-48 in Spokane, Washington, approximately 25,000 barberries were treated with concentrated triethanolamine salt of 2,4-D (40 percent) by applying the chemical to the surfaces of the canes cut as closely to ground level as possible. Complete kill was obtained with one treatment when every cut cane surface was treated, but any cut canes not treated sprouted. The results show that this method can be recommended for killing barberries. This is a good demonstration of a case where a woody plant that is resistant to foliage sprays of 2,4-D can be killed by this chemical when it is applied to freshly cut surfaces. (Contribution of Bureau of Entomology & Plant Quarantine, Agricultural Research Administration, U.S.D.A.)

24

Effect of foliage sprays with various 2,4-dichlorophenoxyacetic acid formulations on native barberries (Berberis canadensis Mill. and B. fendleri Gray.). Molander, L. W., E. A. Lungren, and W. M. Watson. During 1946 and 1947 foliage sprays with various concentrations of sodium salt, amine salts, and several esters of 2,4-dichlorophenoxyacetic acid were applied to quarter-square rod plots of Berberis canadensis in West Virginia and of B. fendleri

in Colorado. For some unexplainable reason the 1946 treatments merely defoliated plants of B. canadensis, which again grew vigorously in 1947. On the other hand, the 1947 treatments gave complete kill of the old canes with very few new sprouts coming up from rhizomes. Further tests will have to be made to explain this inconsistency of results. Berberis fendleri in Colorado was killed by foliage sprays of 2,4-D in both 1946 and 1947. The results of the experiments conducted during these two years were so satisfactory that the spraying of foliage with 2000 p.p.m. of isopropyl ester of 2,4-D is now an established eradication practice. Isopropyl ester is used because it gives the most consistently satisfactory results of any of the formulations of 2,4-D. The 2,4-D formulations were highly effective only on early and mid-season treatments (for Colorado approximately June 1 to August 15). Therefore, this chemical is used in field practice only when the barberries are actively growing. (Contribution of Bureau of Entomology & Plant Quarantine, Agricultural Research Administration, U.S.D.A.)

25

Air blast application of Ammate for the control of scrubby oaks.1/ Elwell, Harry M., and Maurice B. Cox.2/ In preliminary tests (July, 1948) with ORCHARDAIR air blast sprayer3/ it was found that good control of scrubby oak could be obtained with 50 gallons of liquid and 100 pounds of Ammate per acre. The hydraulic type spraying machine, under comparable conditions and control required 300 pounds of Ammate in 300 gallons of water per acre. Thus the air mist machine utilized only one-third as much Ammate and one-sixth as much water as the hydraulic machine.

(1/ Cooperative contribution of Oklahoma Agricultural Experiment Station and Soil Conservation Service Research. 2/ Soil Conservationist and Agricultural Engineer, respectively, Red Plains Conservation Experiment Station, Guthrie, Oklahoma. 3/ Machine furnished by the Davey Tree Expert Company, Kent, Ohio.)

26

Seasonal effect on power saw operation in removing brush and trees.1/ Cox, Maurice B.2/ Results of seasonal cutting of brush and trees with a small portable saw show that more time is required for land clearing during the winter than in the spring and summer. The man hours per thousand trees for the different seasons were: winter - 15.4; spring - 7.4; and summer - 8.0. The major reason for this increased time required for the winter clearing apparently is due to the difficulty in cutting resulting from the dormant stage of the trees. Saw blades remained sharp longer and cut faster during the growing season than during the dormant stage. Winter cutting also requires that saw teeth be more carefully shaped and maintained.

(1/ Cooperative contribution of Oklahoma Agricultural Experiment Station and Soil Conservation Service Research. 2/ Agriculture Engineer, Red Plains Conservation Experiment Station, Guthrie, Oklahoma.)

27

Effect of Mesquite Control on Gains of Yearling Steers. Fisher, C. E., and P. T. Marion. At the close of the 4th summer grazing season on native grassland at the Spur station, yearling steers gained 43 percent more per acre on pasture-land cleared of a moderately heavy stand of mesquite brush. Fourteen head of steers on the cleared pastures from April 10 to October 1, 1948, made an average gain of 206 pounds per head while steers on pastures with mesquite brush gained only 149 pounds. With feeder steers at $28.00 per hundredweight the increased value per steer on the cleared pastures was $15.96 or an increase return of $3.06 per acre. Over a 4-year period the cleared pastures have produced 15 percent more gain per acre and 27 pounds more gain per steer. The grass cover on the cleared pastures remains in good condition and shows moderate use in spite of the two long droughty summers in 1947 and 1948. On brush pastures stocked at the same rate, the grass cover shows very poor

condition, extreme heavy use and large areas of bare soil where forage plants have perished due to heavy use of soil moisture and shading by mesquite. Moderate amounts of mesquite beans were available to steers on upland brush pastures during August and September yet the steers failed to show an increase in gain over those on cleared pastures where no mesquite beans were produced. (Contribution of Texas Agricultural Experiment Station, Spur, Texas.)

28

Chemical Control of Mesquite. Fisher, C. E. Substantial reduction in cost of controlling mesquite on native grassland has been obtained with chemicals in past ten years. Light oils, kerosene, diesel fuel, etc. are highly effective when applied around the base of plant in sufficient amounts to reach the dormant bud zone. Porous soils and single to few stemmed trees free from basal growth are the chief environmental factors determining the effectiveness and cost of oil treatment. Sodium arsenite is highly effective when applied to cut surface of mesquite stumps or when applied to frills at the base of large trees. Chemical solutions applied to foliage have given successful kills only when the atmospheric conditions have favored a long period of moist contact on leaf surface. Heavy machinery including "bulldozers", "stingers" cabling and root plows have been effectively used under certain conditions, but costs often are prohibitive on native pasturelands. (Contribution of Texas Agricultural Experiment Station, Spur, Texas.)

29

Effectiveness of 2,4-D and 2,4,5-T as foliage sprays for control of mesquite. Fisher, C. E. Since 1945 these two chemicals have been tried in various formulations in water on the foliage of mesquite. Under conditions of good soil moisture, rapid growing plants and atmospheric conditions favoring rewetting of foliage by dews or light rains within 18 hours after treatment excellent top kills have been obtained and regrowth from roots did not occur until 10 to 18 months later. Under less favorable conditions 2,4,5-T appeared more toxic than 2,4-D when used at the same concentration on an acid equivalent basis but regrowth was generally normal and rapid. Ester formulations of 2,4-D and 2,4,5-T in diesel oil, kerosene and Base oil 7 gave rapid top kills of mesquite but failed to prevent regrowth. Concentrations, based on acid equivalent basis, below 1000 p.p.m. generally were not toxic, however, 2000 to 4000 p.p.m. of 2,4-D and 2,4,5-T were equally as toxic as higher concentrations ranging up to 25,000 p.p.m. Delayed regrowth from base of plants seemed to be more dependent on length of moist contact that was obtained on foliage following treatment and stage of plant growth than on varying formulations, concentration of solutions or type of diluent used. (Contribution of Texas Agricultural Experiment Station, Spur, Texas.)

30

Comparison of 2,4-D and 2,4,5-T for control of mesquite when applied to the soil around the base of plants and cut surfaces and stubs after top wood has been removed. Fisher, C. E. The addition of 1.25 percent 2,4,5-T isopropyl ester to diesel oil increased the percentage kill of mesquite plants from 12 to 77 percent over diesel oil when 8 ounces of the solution was applied to the soil with a chemical weed gun. Spraying cut surfaces and stubs with a 2.5 percent solution or suspension of 2,4,5-T isopropyl ester in diesel oil, kerosene, naptha, Shell base oil No. 7 or water gave more effective kills of mesquite plants in April, May and June than similar amounts of 2,4-D of the isopropyl ester and butyl ester in water or oils or as the amine or sodium salt in water solutions. (Contribution of Texas Agricultural Experiment Station, Spur, Texas.)

31

Comparison of the toxicity of 2,4-D and 2,4,5-T to Ribes. Offord, H. R., and V. D. Moss. Chief objective of the 1948 blister rust control work for improving chemical eradication methods was to test new formulations of growth-regulating substances on Ribes species not readily killed by 2,4-D. On 446 plots in seven far Western states, 14 Ribes species were treated with 2,4-D, 2,4,5-T and 2,4-D + 2,4,5-T. Salts, esters, and pure acid formulations of the phenoxy compounds were used in appropriate oil and water diluents, and both 2,4-D and 2,4,5-T were tested in combination with Ammate, Geon latex, ammonium trichloroacetate, sodium trichloroacetate, pentachlorophenol, sodium pentachlorophenate, and tributyl phosphate. Methods of applying the herbicide were: spraying leaves and stems of intact plants, decapitating plants near the ground line and applying phenoxy concentrate in oil or water to the freshly cut surface of the root crown, applying phenoxy concentrate in Diesel oil or kerosene to the intact basal stems. Most Ribes species were killed effectively by the three methods of treatment. 2,4,5-T proved to be significantly better than 2,4-D as a general purpose herbicide on Ribes, being much less selective than 2,4-D. Ribes lacustre, R. binominatum, R. inerme, and R. montigenum can be killed by spraying with 2,000 p.p.m. 2,4,5-T, whereas these same species were not significantly damaged by equivalent dosages of 2,4-D. Variation in kill with seasonal growth changes of Ribes was less marked with 2,4,5-T than with 2,4-D. Relationship between concentration and optimum kill appears to be more critical for 2,4,5-T than for 2,4-D. This minimum concentration of 2,4,5-T needed to kill the several Ribes species varied from 250 p.p.m. for R. bracteosum to about 2,000 p.p.m. for R. binominatum. The two phenoxy compounds can be combined with good results on Ribes provided the percentage of 2,4,5-T in the mixture does not drop below 50. (Contribution of Division of Plant Disease Control, Bureau of Entomology and Plant Quarantine, U.S. Department of Agriculture, Berkeley, California.)

32

Tests of the helicopter over mountain terrain for spraying woody perennials (Ribes) with 2,4-D. Offord, H. R. First tests of the helicopter for spraying Ribes with 2,4-D were made on the Sierra National Forest, California, June 21-25, 1948. The objectives of these tests were to determine (1) the effects of ground cover, terrain, elevation, and weather on the operating efficiency of a helicopter being used for spraying, and (2) the volume of diluent and weight of 2,4-D needed to kill Ribes spp. in various ecologic sites. A Bell model 47 B3 equipped with a 44-nozzle boom was effectively flown within 30 feet of the ground at elevations of 5200-6000 feet. The maximum load carried was 30 gallons. Sixteen plots (from 1 to 5 acres) were sprayed with the following 2,4-D formulations: Iso-propyl ester in straight Diesel oil, aqueous iso-propyl ester plus a sticker-spreader, aqueous alkanolamine, aqueous ammonium salt plus summer oil plus sticker-spreader. Dosages per acre were from 5 to 30 gallons and from 3-1/3 to 40 ounces 2,4-D acid. Observations 6 weeks after treatment showed that 2,4-D ester in straight Diesel oil was generally more toxic to Ribes and associated brush than the esters or salts diluted with water. Oil solutions apparently settle and wet the vegetation with greater uniformity than aqueous solutions. The apparent kill could be correlated with the dosage of 2,4-D used. Sixteen ounces 2,4-D acid or more per acre resulted in uniform damage of R. roezli, R. nevadense, and other susceptible plants growing on the plots. In general the apparent kill of Ribes and of susceptible brush correlates closely with the density of spray deposit recorded by test plates. Discs of filter paper gave an excellent record of spray deposit for aqueous solutions dyed red; glass plates were best for recording oil solutions. Most uniform coverage was obtained on plots where slopes and ground obstructions permitted spraying from two opposing directions. (Contribution from Division of Plant Disease Control, Bureau of Entomology and Plant Quarantine, U.S. Department of Agriculture, Berkeley, California.)

Second year results of Alder brush eradication tests, Plot 100, Sub plots 1 to 40, Argonne Experimental Forest, Wisconsin. Stoeckeler, J. H. On June 29 and 30, 1947, an experiment was installed involving various methods of control of alder brush near Hiles, Wisconsin. Results based on counts made June 29, 1948 are listed in the table below.

Treatment No.	Type of Treatment	Strength of Treatment Used	Percentage increase or decrease: old alder	Percentage increase or decrease: sprout alder	Percentage increase or decrease: all sizes	Relative effectiveness: For roadside maintenance	Relative effectiveness: For release of planted or natural trees 1/
1	Weedone spray on foliage	1 Qt. in 25 Gal. water	-47	+2	-32	Poor	Fair
2	Esteron spray on foliage	3 Pts. in 50 Gal. water	-67	-21	-48	Fair	Good 3/
3	Ammate spray on foliage	4 Lbs. per Gal. water	-63	-89	-85	Fair	Good
4	Di Nitro Cresylate spray	5% water spray	-48	+57	-25	Poor	Poor
5	Cut old brush in May, spray Esteron in August	3 Pts. in 50 Gal. water	-95	-90	-93	Good 2/	Good
6	Cut old brush in May, spray Ammate in August	4 Lbs. in 1 Gal. water	-100	-46	-82	Good	Good
7	Cut brush flush with ground, daub with Ammate	4 Lbs. in 1 Gal. water	-96	+2	-51	Poor	Good
8	Cutting only May 1947	----------	-94	+228	+34	Poor	Fair 4/
9	Cutting only August 1947	----------	-97	+116	-25	Poor	Fair 5/
10	Check	----------	-20	+129	-20	----	----

1/ For release of planted or natural trees of valuable species complete kill is not as essential as for roadside maintenance.
2/ & 3/ Cheapest effective treatment to date.
4/ & 5/ Temporary benefit.

Symbol + means plus.

(Contribution of Lake States Forest Experiment Station, U.S.D.A., St. Paul, Minnesota.)

Results of 1948 Tests of Sprays Along Telephone Lines to Control Sprout and Seedling Growth of Native Trees and Other Vegetation in Northern Wisconsin. Plots 106 and 107, Nicolet National Forest, Wisconsin. Stoeckeler, J. H. In the period July 26 to 30, 1948, two areas consisting of 0.6 miles and 0.8 miles respectively, of Nicolet National Forest telephone line were sprayed using Esteron 44 at a strength of 1 to 160 and Esteron 245 at 1 to 133 and Ammate at 1 lb. per 5 gallons of water. The Ammate was used at a somewhat lower dosage than normally recommended. Weedone was also used at 1 to 70 and 1 to 80, but was not as effective as Esteron 44. There was no large difference in the relative effectiveness of Esteron 44 and Esteron 245. The first year results are summarized in the table below.

Relative Susceptibility of Various Species of Plants

Rating	Using Esteron		Using Ammate	
	3-month-old sprouts	8-year-old sprouts or trees	3-month-old sprouts	8-year old sprouts or trees
Easy to kill	Hazel Sumac Pin Cherry Dwarf willow Paper birch Alder	Hazel Sumac Pin Cherry Dwarf willow	Hazel Sumac Pin Cherry Dwarf willow Alder	Hazel Sumac Pin Cherry Dwarf willow
Moderately difficult to kill	Aspen Red maple American elm Boxelder Gooseberry Raspberry Elderberry	Paper birch Red maple American elm. Aspen Gooseberry Elderberry Alder	Paper birch Yellow birch Red maple Mtn. maple American Elm Gooseberry Raspberry Elderberry Bracken fern	Paper birch Red maple American elm Elderberry Alder Gooseberry
Hard to kill	Hard maple Basswood White ash Red oak Blackberry Bracken fern Dogwood	Hard maple Basswood White ash Wild plum Red oak Blackberry Raspberry Balsam fir White spruce White pine	Hard maple Basswood White ash Blackberry	Hard maple Basswood White ash Blackberry Raspberry Balsam fir White spruce White pine

(Contribution of Lake States Forest Experiment Station, U.S.D.A., St. Paul, Minnesota.)

35
Effect of 2,4-D on buckbrush (Symphoricarpos orbiculatus). Woestemeyer, V.W., and H. E. Stucky. Buckbrush was sprayed with 2,4-D at rates ranging from three-fourths to two pounds acid in the ester form, and one and two pounds acid in the amine form. Spray was applied June 16 near the latter part of the rapid growth period. All ester plots were completely defoliated in a month except on the one pound plot in which three or four plants retained a few leaves for over two months. Plants receiving two pounds of amine gradually turned color and by early fall the leaves were nearly yellow, but had not started to drop. One pound of amine had no visible effect. No new growth appeared on the ester plots during the remainder of the season. (Contribution of Kansas Agricultural Experiment Station and McPherson County, Kansas, Noxious Weed Department.)

36
Field trials with 2,4-D for control of poison oak (Rhus diversiloba). Koehler, James W. This is a continuation of our report on page 10 of "Report of the Subcommittee on Research Concerning the Eradication of Woody Plants--1947." During 1948 the area was sprayed again. It was noted that the 1947 treatment had decreased the poison oak density by an estimated 10%. The first treatment in May 1948, with 18 ozs. of a 2,4-D ester in 10 gallons of water applied per acre failed. It is believed the failure was due to cool weather and high rainfall which immediately followed the application. On July 13 the area was again sprayed--this time with two pounds of the parent acid of a butyl ester of 2,4-D in 10 gallons of diesel oil per acre. Observations in September indicated that a high percentage of plants appeared to be killed. October observations showed approximately 20% regrowth of treated plants. (Contribution of the Bureau of Reclamation, Region II, Sacramento Valley District, Chico, California.)

37
A comparison of Na salt and isopropyl ester of 2,4-D at three rates and isopropyl ester of 2,4,5-T at one rate of acid per acre applied as a foliage spray to control salt cedar (Tamarix gallica) - Yuma, Arizona. Bowser, Curtis W. Airplane applications of 2,4-D and 2,4,5-T were made during early May 1948 to dense, mature, salt cedar growth in full-bloom stage. Flagging in dense undergrowth was done with hydrogen-filled weather observation balloons tied on long cords. Monohydrated 60 percent Na salt was mixed with fuel oil of 25° gravity, detergent, and water, then applied at rate of 3,4, and 5 pounds acid per acre. Isopropyl ester of 2,4-D was mixed with oil only and also applied at the same rates. One additional plot was sprayed with 4 pounds acid isopropyl ester 2,4,5-T per acre. Herbicides were applied at rate of 15 gallons total liquid per acre. Defoliation of salt cedars was most rapid and noticeable on plots receiving heaviest acid applications. Regrowth following each defoliation, occurred several times during the summer. New growth was characteristically malformed and light in color. Fall 1948 estimates of eradication ran to 80 percent on the 4- and 5-pound acid per acre treated plots but only 50 percent kill, mostly of young plants, by the 3-pound acid per acre applications. No outstanding differences were noted in the early fall between the plot sprayed with 2,4,5-T and one which received 4 pounds acid isopropyl ester per acre. Plots treated with ester consistently show better kill of plants than those sprayed with Na salt. An adjacent 7-acre plot also was sprayed during May with 5 pounds isopropyl ester 2,4-D in Diesel oil as required to make total volume of 15 gallons liquid per acre. Aromatic content of oil used evidently was responsible for acute injury to leaves and complete defoliation of plants within 5 days. Re-treatment was necessary during August to check basal regrowth. Conclusions are that two treatments, each of 4 pounds acid 2,4-D in 15 gallons liquid per acre, are

necessary during season to eradicate mature salt cedars. Carrier for herbicide in areas of low humidity should be a light oil (containing mostly heavy unsaturated which exercise chronic injury to foliage) which serves mainly for its additional penetrating and wetting properties.
(Contribution of Bureau of Reclamation, U.S. Department of the Interior.)

TABLES SHOWING REACTIONS OF WOODY PLANTS TO 2,4-D, 2,4,5-T, AND COMBINATIONS OF THESE TWO CHEMICALS

There are four tables showing reactions of woody plants included in this report as follows:

1. To 2,4-D.
2. To 2,4,5-T.
3. To combination of 2,4-D and 2,4,5-T. (A summary submitted by F. A. Ashbaugh, Pittsburgh, Pa.)
4. To combination of 2,4-D and 2,4,5-T. (A summary submitted by W. A. Bodwell, Manchester, N. H.)

NOTE: BE SURE TO FAMILIARIZE YOURSELF WITH THE FOLLOWING LEGEND BEFORE STUDYING THE RESULTS GIVEN IN THE TABLES:

1. TYPES OF TREATMENT: Foliage spray (FS), Cut Surfaces (CS), Dormant spray (DS), and Ax gashes (AG)

2. TYPES OF PHYSIOLOGICAL REACTIONS:

Reaction Type - I (hypersensitive) - Any plant that is killed in certain designated stages of growth by one application of a given chemical.

II (sensitive) - Any plant that in certain designated stages of growth reacts to a given chemical and may be killed by repeated applications.

III (semi-tolerant) - Any plant that in certain designated stages of growth reacts to a given chemical but is not killed by repeated applications.

IV (tolerant) - Any plant that in designated stages of growth shows negligible reaction to a given chemical.

REACTIONS OF WOODY PLANTS TO 2,4-D

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth						State	Authority
				Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Late Season: Dormant		
Alder	Alnus rugosa	1100-3300 PPM	FS		III	III	II	II	III	USFS	PJZ
		Est.3pt-50 gal.	FS	I	I	II				USFS	JHS
		Weedone 1/100	FS	I	II	III				USFS	JHS
Apple, Amer. Crab	Pyrus coronaria	Esters 3000 PPM	FS	I	II	II	II	III		Pa.	FAA
Apple, common	Pyrus malus	Esters 3000 PPM	FS	IV	IV	IV	IV	IV		Pa.	FAA
Ash	Fraxinus spp.	Ester, 2000 PPM	FS	IV	IV					Iowa	ALB
Ash, green	Fraxinus pennsylvanica	Conc. E. & S.	FS		III	III	III	III		A&T	TVA
Ash, white	Fraxinus americana	Esters, 3000 PPM	FS	IV	IV	IV	IV	IV		Pa.	FAA
		Est. 44 1/160	FS			III				USFS	JHS
Aspen (See poplar)											
Barberry, European	Berberis vulgaris	Conc. E. & A.	CS		I	I	I	I	I	Minn.	LWM
Barberry, Jap.	Berberis thunbergii	Amines 2000 PPM	FS		IV					Nebr.	DLK
Barberry, Native Colorado	Berberis fendleri	Iso. ester 2000	FS	I	I	I	II	II		Colo.	M&L
Basswood	Tilia americana	Esters 3000 PPM	FS	IV	IV	IV	IV	IV		Pa.	FAA
		Est.44 1/160	FS			III				USFS	JHS
Birch	Betula papyrifera	1100 - 3000 PPM	FS		III	III	II	II	III	USFS	PJZ
		Est.44 1/160	FS			II				USFS	JHS
Birch, river	Betula nigra	Conc. E. & S.	FS	I		I	I			A&T	TVA
Bittersweet	Celastrus scandens	Ester, 2000 PPM	FS		IV	IV				Iowa	ALB
Blackberry	Rubus spp.	Ester, 2000 PPM	FS		IV	IV				Iowa	ALB
		Conc. E. & S.	FS		III	III	III	III		A&T	TVA
		A & E 2 lb.	FS			IV	IV			Idaho	LCE
		Iso.Ester 375 PPM	FS			IV				Ore.	WCB
Blackberry, wild	Rubus allegheniensis	Esters 3000 PPM	FS	IV	IV	IV	IV	IV		Pa.	FAA

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Dormant	State	Authority
Brier, common green	Smilax rotundifolia	Ester, 3000 PPM	FS	III	IV	IV	IV	IV		Pa.	FAA
		I.Ester 3000 PPM	FS		IV					Mich.	C&D
Buckbrush (Also see Snow & Wolfberry)	Symphoricarpos spp.	Ester 2000 PPM	FS		IV	IV	IV	IV		Colo.	EAL
		Conc. E. & A.	FS		II	II	II			Ill.	S&F
		I.Ester 2000 PPM	FS		III					Mich.	C&D
Buckbrush	Symphoricarpos occidentalis	B.Ester 1000 PPM	FS			II	II			Iowa	EPS
Buckbrush	Symphoricarpos orbiculatus	Esters 2000 PPM	FS	I	I	I	I			Okla.	HME
		Ester 1500 PPM	FS	I	II	II	III			Kan.	Z&M
Burning bush (See Waahoo)	Euonymus atropurpureus									Mo.	LVS
Buttonball	Cephalanthus occidentalis	Conc. E. & S.	FS		III	III	III	III	IV	A&T	TVA
Cedar, red	Juniperus virginiana	Ester, 2000 PPM	FS		IV	IV	IV			Iowa	ALB
		Esters 2000 PPM	FS	IV	IV	IV	IV			Okla.	HME
Cherry, choke	Prunus spp.	Ester, 2000 PPM	FS	II	II	II				Iowa	ALB
		Amine, 3000 PPM	FS		IV					Nebr.	OLK
		I Ester, 4000 PPM	DS						I	Mich.	MWD
Cherry, wild	Prunus serotina	Esters, 3000 PPM	FS	I	I	I	I	II		Pa.	FAA
Cinquefoil, shrubby	Potentilla fruticosa	Amine $\frac{1}{2}$,1,1$\frac{1}{2}$,2 lb.	FS					IV		Alta.	JJS
		B.Ester $\frac{1}{2}$,1,1$\frac{1}{2}$, 2 lb.	FS					IV		Alta.	JJS
Cottonwood	Populus deltoides	Ester, 2000 PPM	FS		III	III				Iowa	ALB
		Conc.E & A 1 lb.	FS		III/IV					Okla.	EHM
		Esters,3000 PPM	FS	II	II	II	II	II		Pa.	FAA
Currant, Alpine	Ribes montigenum	1000 ≠ PPM E&S	FS/CS	III	IV	IV	IV	IV	IV	C Etal	HRO
Currant, black	Ribes nigrum?	Ester 1$\frac{1}{2}$ lb.	FS	IV	IV	IV				Man.	HEW
Currant, prickly	Ribes lacustre	1000 ≠ PPM E&S	FS/CS	III	IV	IV	IV	IV	IV	C Etal	HRO
Currant, red flower	Ribes sanguinem	E & S 750 ≠ PPM	FS/CS	I	II	II	III	III		C Etal	HRO

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Late Season: Dormant	State	Authority
Currant, Sier.Nev.	Ribes nevadense	E&S 500 ≠ PPM	FS/CS	I	I	I	II	II		C Etal	HRO
Currant, Squaw	Ribes cereum	E&S 1000 ≠ PPM	FS/CS	I	II	II	II	II		C Etal	HRO
Currant, sticky	Ribes viscosissimum	E&S 1000 ≠ PPM	FS/CS	I	II	II	III	III		C Etal	HRO
Currant, stink	Ribes bracteosum	E&S 250 ≠ PPM	FS	I	I	I	II	II		C Etal	HRO
Currant, West.black	Ribes petiolare	E&S 250 ≠ PPM	FS/CS	I	I	I	II	II		C Etal	HRO
Currant, wild	Ribes oreophilus	Ester, 2000 PPM	FS		III	III	IV	IV		Colo.	EAL
Cypress, Bald	Taxodium distichum	Conc. E. & S.	FS		IV	IV	IV	IV		A&T	TVA
Dewberry	Rubus vilosus	Esters, 3000 PPM	FS	III	III	III	III	IV		Pa.	FAA
Dogwood	Cornus stolonifers	Ester 1½ lb.	FS		IV	IV				Man.	HEW
Dogwood, flowering	Cornus florida	Esters, 3000 PPM	FS	I	II	II	II	III		Pa.	FAA
Dogwood, Gray	Cornus asperifolia	Ester 2000 PPM	FS		II	II	III			Kan.	Z&M
Elderberry	Sambucus canadensis	Ester 1500 PPM	FS	I	I	II	II			Kan.	Z&M
	Sambucus spp.	Ester 2000 PPM	FS	II	II	II				Iowa	ALB
Elder, Box	Acer negundo	Ester, 2000 PPM	FS	II	II					Iowa	ALB
		E & A 1½ lb.	FS	II	II	II				Man.	HEW
		B.Ester 1000 PPM	FS			I	I			Iowa	EPS
		Esters 3000 PPM	FS	I	I	I	I	I		Pa.	FAA
Elder, Common	Sambucus canadensis	Esters, 3000 PPM	FS	I	I	I	II	II		Pa.	FAA
		Ester 1500 PPM	FS	I	I	II	II			Kan.	Z&M
Elm	Ulmus spp.	Esters 3000 PPM	FS	I	I	I	I	II		Pa.	FAA
Elm, American	Ulmus Americana	Ester, 2000 PPM	FS		III	III				Iowa	ALB
		Esters 2000 PPM	FS	III	III	IV	IV	CS IV		Okla.	HME
		Esters 3000 PPM	FS	I	I	I	I	II		Pa.	FAA
		Ester 20%	CS			I	I			Kan.	Z&M
Elm, Jap.	Ulmus japonica	Ester, 2000 PPM	FS	I	I	II	II			Kan.	Z&M
Elm, red	Ulmus fulva	Amine, 3000 PPM	FS		III					Nebr.	DLK
		B.Ester 1000 PPM	FS			II	II			Iowa	EPS
Elm, Winged	Ulmus alata	Esters 2000 PPM	FS	III	III	IV	IV	CS IV		Okla.	HME

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Late Season: Dormant	State	Authority
Gooseberry	Ribes spp.	Ester 1½ lb.	FS	IV	IV	IV				Man.	HEW
	Ribes oxyacanthoides	E & S 2000 PPM	FS			I	I			Minn.	ALL
Gooseberry, gummy	Ribes lobbii	E & S 1000 + PPM	FS/CS	II	II	II	III	III		C Etal	HRO
Gooseberry, Sier. Nev.	Ribes roezli	E & S 250 + PPM	FS/CS	I	I	I	II	II	II	C Etal	HRO
Gooseberry, Siskiyou	Ribes binominatum	E & S 2000 + PPM	FS	II	II	II	III	III		C Etal	HRO
Gooseberry, White St.	Ribes inerme	E & S 2000 + PPM	FS	II	II	II	III	III		C Etal	HRO
Gooseberry, wild	Ribes sitosum		FS			III				Sask.	HAF
Grape, wild	Vitus vulpina	Ester 2000 PPM	FS		II	II				Iowa	ALB
		E & A 1 lb. acid	FS		III					Okla.	EHM
		B. Ester 1000 PPM	FS			I			CS I	Iowa	EPS
		Esters 3000 PPM	FS	I	I	I	I	I		Pa.	FAA
Gum, sweet	Liquidambar styraciflua	Conc. E & S	FS		II	II	II	II		A&T	TVA
		Am. salt 4500 PPM	FS	I	I	I	I			SC	LEC
Gum, tupelo	Nyssa sylvatica	Conc. E & S	FS	I			I	I		A&T	TVA
		Am. salt 4500 PPM	FS	I	I	I	I			SC	LEC
Hackberry	Celtis mississippiensis	Conc. E & S	FS	I		I	I	I		A&T	TVA
Hackberry	Celtis occidentalis	Ester 2000 PPM	FS		III	III				Iowa	ALB
		ES&A 1 lb. acid	FS	III/IV	III/IV					Okla.	EHM
		Esters 2000 PPM	FS	III	III	IV	IV	CS IV		Okla.	HME
		Ester, 20%	CS			I	I			Kan.	Z&M
		Ester 2000 PPM	FS	I		I	II			Kan.	Z&M
Hawthorn	Crataegus spp.	Ester 2000 PPM	FS	II	II	II				Iowa	ALB
		Esters, 3000 PPM	FS	II	III	III	IV	IV		Pa.	FAA
Hazel	Corylus cornuta	I Ester 4000 PPM	DS						I	Mich.	MWD
Hazel brush	Corylus spp.	Ester 2000 PPM	FS	II	II	II				Iowa	ALB
Hazel nut	Corylus americana	Conc. E & S	FS				I			A&T	TVA
		Iso. Ester 1000 PPM	FS			II	II			Iowa	EPS
		1100 - 3300 PPM	FS		II	I	I	I	II	USFS	PJZ

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Dormant	State	Authority
Hickory	Hicoria buckeyi	Esters 2000 PPM	FS	II	II	II	II	CS III		Okla.	HME
Hickory, Shellbark	Carya ovata	Esters, 3000 PPM	FS	II	III	III	III	III		Pa.	FAA
Ivy, poison	Rhus toxicodendron	Ester 2000 PPM	FS	II	II	II				Iowa	ALB
		Amine 3000 PPM	FS		IV					Nebr.	DLK
		Ester 1½ lb.	FS	II	II	II				Man.	HEW
		B. Ester 1000 PPM	FS			I	I			Iowa	EPS
		Conc. E,A, & S	FS	II	II	II	II	II		Ill.	S&F
		Esters, 3000 PPM	FS	I	II	II	II	III		Pa.	FAA
		Conc. Esters	FS		I	I	II	II	IV	Ohio	WJG
		I Ester 2000 PPM	FS		II	II	II			Mich.	C&D
		Amine 2000 PPM	FS			II	II			Mich.	C&D
	Rhus radicans	Acid & Carbo 1000 PPM	FS		II	II	III	III		Ont.	WHW
		" " " 2000PPM	FS		I-II	II	II-III	III		Ont.	WHW
		M.Ester 2000 PPM	FS		I-II	II	II	III		Ont.	WHW
Juneberry	Amelanchier sp.	1100-3300 PPM	FS		III	II	I	I	II	USFS	PJZ
Juniper	Juniperous utahensis	Ester 2000 PPM	FS		IV	IV	IV	IV		Colo.	EAL
Lead plant	Amorpha canescens	Ester 2000 PPM	FS		III	III	IV	IV		Kan.	Z&M
Licorice	Glycyrrhiza lepidota	Ester, 2000 PPM	FS	II	II	II				Iowa	ALB
Lilac, Common	Syringea vulgaris	Ester 1½ lb.	FS	IV	IV					Man.	HEW
Locust, Black	Robinia pseudoacacia	E & A 2 lb.	FS			II	II	III		Idaho	LCE
		Esters 2000 PPM	FS&CS	I	I	II	II			Okla.	HME
		Ester, 3000 PPM	FS	I	I	I	II	II		Pa.	FAA
Locust, Honey	Gleditsia triacanthos	Ester, 2000 PPM	FS		III	III				Iowa	ALB
		B.Ester 1500 PPM	FS			III/IV	III/IV			Iowa	EPS
		Esters 2000 PPM	FS&CS	I	I	II	II			Okla.	HME
Mahonia	Mahonia repens	Ester, 2000 PPM	FS		IV	IV	IV	IV		Colo.	EAL
Maple	Acer spp.	Ester, 2000 PPM	FS		IV	IV				Iowa	ALB
Maple, Norway	Acer platanoides	Ester ?	CS						IV	Idaho	LCE

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Maple, Red	Acer rubrum	Esters 3000 PPM	FS	III	IV	IV	IV	IV		Pa.	FAA
		I Ester 4000 PPM	DS						II-III	Mich.	MWD
		Ester 44-1/160	FS			III				USFS	JHS
Maple, soft or silver	Acer saccharinum	Conc. E. & S.	FS		III	III	III	III		A&T	TVA
Maple, Sugar	Acer saccharum	Esters, 3000 PPM	FS	III	IV	IV	IV	IV		Pa.	FAA
		Ester 44-1/160	FS			III				USFS	JHS
Mesquite	Prosopis juliflora glan.	Esters 2000 PPM	FS	III	III	IV	IV	CS IV		Okla.	HME
	Prosopis juliflora	2000 PPM Diesel	FS	III	III	III	III	III	IV	Texas	CEF
		5000 PPM Diesel	FS	III	III	III	III	III	IV	Texas	CEF
		10000 PPM Diesel	FS	III	II	II	III	III	III	Texas	CEF
		25000 PPM Diesel	FS	III	II	II	III	III	III	Texas	CEF
		2,000 PPM Water	FS	III	III	III	IV	IV	IV	Texas	CEF
		5,000 PPM Water	FS	III	II	II	III	IV	IV	Texas	CEF
		10000 PPM Water	FS	III	II	II	II	IV	IV	Texas	CEF
		25000 PPM Water	FS	III	II	II	II	III	IV	Texas	CEF
		20000 PPM Diesel	CS	III	III	III	III	III	III	Texas	CEF
		5000 PPM Diesel	CS	III	III	III	III	III	III	Texas	CEF
		10,000 PPM Diesel	CS	III	III	III	III	III	III	Texas	CEF
		25,000 PPM Diesel	CS	III	III	III	III	III	III	Texas	CEF
		25,000 PPM Water	CS	III	III	III	III	III	III	Texas	CEF
Moonseed	Menispermum canadense	Ester, 2000 PPM	FS	II	II	II				Iowa	ALB
Mulberry	Morus alba	Ester, 2000 PPM	FS		IV	IV				Iowa	ALB
		Amine, 3000 PPM	FS		IV					Nebr.	DLK
		Ester, 20%	CS			II	II			Kan.	Z&M
		Ester, 2000 PPM	FS		II	II	III			Kan.	Z&M
Mulberry, red	Morus rubra	Iso. Ester 1500 PPM	FS			IV	IV			Iowa	EPS

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Late Season: Dormant	State	Authority
Oak	Quercus spp.	Ester, 2000 PPM	FS		IV	IV				Iowa	ALB
		I Ester 2000 PPM	FS					III		Mo.	LVS
		1100-3300 PPM	FS		IV	III	II	III	IV	USFS	PJZ
Oak, Black Jack	Quercus marilandica	Esters 2000 PPM	FS	II	II	II	II	CS III		Okla.	HME
Oak, Bur	Quercus macrocarpa	Amine, 3000 PPM	FS		IV					Nebr.	DLK
		Ester 1½ lb.	FS	III	III/IV	III/IV				Man.	HEW
		B.Ester 1500 PPM	FS			II	II			Iowa	EPS
Oak, Dwarf Chinq.	Quercus muhlenbergii	Esters 2000 PPM	FS	II	II	II	II	CS III		Okla.	HME
Oak, Laurel	Quercus imbricaria	Esters 3000 PPM	FS	III	III	III	IV	IV		Pa.	FAA
Oak, poison	Rhus diversiloba	B.Ester in D oil	FS		II	II	II			Calif.	JWK
Oak, Post	Quercus stellata	Esters, 2000 PPM	FS	II	II	II	II	CS III		Okla.	HME
Oak, Red	Quercus rubra (borealis)	Esters 3000 PPM	FS	III	III	III	IV	IV		Pa.	FAA
		Est. 44-1/160	FS			III				USFS	JHS
Oak, Scrub	Quercus gambelii	Iso.Ester 2000 PPM	FS	III	IV	IV	IV	IV		Colo.	EAL
Oak, Shin	Quercus havardi	E,S, & A 1 lb.acid	FS		III					Okla.	EHM
Oak, White	Quercus alba	Esters 3000 PPM	FS	III	III	III	IV	IV		Pa.	FAA
Osage Orange	Maclura pomifera	Ester, 2000 PPM	FS		IV	IV				Iowa	ALB
		Ester, 2000 PPM	FS		IV					Nebr.	DLK
		I.Ester 1500 PPM	FS			IV	IV			Iowa	EPS
		Esters 2000 PPM	FS	IV	IV	IV	IV			Okla.	HME
		Esters 3000 PPM	FS	IV	IV	IV	IV	IV		Pa.	FAA
		Ester Conc.Ester	CS			II?	II?			Kan.	Z&M
		Ester 2000 PPM	FS		III	III	III			Kan.	Z&M
Papaw	Asimina triloba	I Ester 3000 PPM	FS			IV				Mich.	C&D
Pear, Prickly	Opuntia humifusa	Conc.E,A,& S 1 lb.	FS		II/III					Okla.	EHM
Persimmon	Diospyros virginiana	Esters 2000 PPM	FS	II	II	II	II	CS III		Okla.	HME
		Ester, 2000 PPM	FS	II	II					Ill.	S&F
		Ester 20%	CS			II	II			Kan.	Z&M
		Ester, 2000 PPM	FS			II	III			Kan.	Z&M

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Late Season: Dormant	State	Authority
Pine	Pinus spp.	Ester, 2000 PPM	FS		IV	IV	IV			Iowa	ALB
Pine, Loblolly	Pinus taeda	Am.salt 4500 PPM	FS	I	I	I	I			SC	LEC
Pine,Western Yel.	Pinus ponderosa	Ester, 2000 PPM	FS		IV	IV	IV	IV		Colo.	EAL
Plum, Sand	Prunus angustifolia	E,S,& A 1 lb.acid	FS	IIorIII	II/III					Okla.	EHM
		Esters 2000 PPM	FS	I	I	I	I			Okla.	HME
Plum, Wild	Prunus americana	Ester, 2000 PPM	FS		I	II	II			Kan.	Z&M
Poplar	Populus spp.	Ester, 2000 PPM	FS	II	II	II				Iowa	ALB
Poplar, Black	Populus balsamifers	Ester 1½ lb.	FS	II	II	II/III				Man.	HEW
		Conc. B. Ester	FS			I				Alta.	ACC
Poplar, White (Aspen)	Populus tremuloides	Ester 1½ lb.	FS	II	II	IV	IV	IV	IV	Man.	HEW
			FS	I						Sask.	HAF
		1100-3300 PPM	FS		III	II	I	II	III	USFS	PJZ
		Esters 3000 PPM	FS	II	II	II	III	III		Pa.	FAA
Prickly Ash	Xanthoxylum americanum	E & S 2000 PPM	FS			I	I			Mim.	ALL
Raspberry	Rubus spp.	Amine 3000 PPM	FS		IV					Nebr.	DLK
Rose, prairie	Rosa pratincola		FS			IV				Sask.	HAF
Rose, wild	Rosa arkensana	B.Ester 1 lb.	FS		IV	IV	IV	IV		Alta.	ACC
		E & A 2 lb.	FS			III/IV	IV			Alta.	JJS
	Rosa spp.	Ester, 2000 PPM	FS		IV	IV	IV			Iowa	ALB
		Amine 3000 PPM	FS		IV					Nebr.	DLK
		E & A 2 lb.	FS		IV	IV	IV	IV		Idaho	LCE
		Ester 1½ lb.	FS	IV	IV	IV				Man.	HEW
		Iso.Ester 2000 PPM	FS		IV	IV	IV	IV		Colo.	EAL
		1100-3300 PPM	FS		IV	III	II	III	IV	USFS	PJZ
Sagebrush, sand	Artemissia filifolia	E,S,& A 1 lb.acid	FS	II	II	III	IIIorIV	IIIorIV		Okla.	EHM
Sassafras	Sassafras albidum	Esters, 2000 PPM	FS		II	II	II			Ill.	S&F
		Esters, 3000 PPM	FS	I	I	I	I	I		Pa.	FAA
Silverberry	Eleagans commutata		FS	I		II				Sask.	HAF

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Dormant	State	Authority
Skunkbush	Rhus trilobata	I.Ester 1500 PPM	FS	I	I-II	II	II			Kan.	Z&M
Skunkbush	Rhus trilobata	E,S,& A 1 lb.acid	FS	II	II					Okla.	EHM
Snowberry	Symphoricarpos albus	Ester 1½ lb.	FS	II	II	IV	IV	IV	IV	Man.	HEW
			FS	I		II				Sask.	HAF
		Ester 2000 PPM	FS		III	III				Iowa	ALB
		Esters 1 lb.	FS			II				Alta.	JJS
Soapweed	Yucca glauca	Conc.E,A,& S 1 lb.	FS		II/III					Okla.	EHM
Spicebush	Benzoin aestivale	Esters 3000 PPM	FS	I	I	I	I	II		Pa.	FAA
Spruce	Picea spp.	Ester, 2000 PPM	FS		IV	IV	IV			Iowa	ALB
		Ester, 2000 PPM	FS		IV	IV	IV	IV		Colo.	EAL
Sumac	Rhus spp.	Ester, 2000 PPM	FS	II	II	II				Iowa	ALB
		Ester 2000 PPM	FS	I	I	I	II	II		Ill.	S&F
Sumac, smooth	Rhus glabra	E,S,& A 1 lb.acid	FS	II	II					Okla.	EHM
		Esters 2000 PPM	FS	I	I	I	I			Okla.	HME
Sumac, Staghorn	Rhus typhina	Esters, 3000 PPM	FS	I	I	I	I	I		Pa.	FAA
Sycamore	Plantanus	Conc.Esters & Salts	FS	I		I	I	I		A&T	TVA
	occidentalis	Esters, 3000 PPM	FS	I	II	II	II	II		Pa.	FAA
Tea, New Jersey	Ceanothus ovatus	Ester, 2000 PPM	FS		II	II	II			Kan.	Z&M
Tree of Heaven	Ailanthus glandulosa	Esters, 3000 PPM	FS	I	I	I	II	II		Pa.	FAA
Trumpet vine	Tecoma radicans	Ester, 2000 PPM	FS	II	II	II				Iowa	ALB
		Conc. E. & S.	FS			I	I			A&T	TVA
Tulip Tree	Lirodendron tulipifera	Esters 3000 PPM	FS	I	I	I	II	II		Pa.	FAA
Virginia creeper	Psedera quinquifolia	Ester, 2000 PPM	FS	II	II	II				Iowa	ALB
		B Ester 1000 PPM	FS			I			CS-I	Iowa	EPS
Waahoo	Euonymus atropurpureus	Ester 3000 PPM	FS		IV					Nebr.	DLK
Walnut, black	Juglans nigra	Ester, 2000 PPM	FS		II	II				Iowa	ALB
		Esters, 3000 PPM	FS	III	III	III	IV	IV		Pa.	FAA
Walnut, White	Juglans cinerea	Esters 3000 PPM	FS	I	II	II	III	III		Pa.	FAA
Willow	Salix spp.	Ester, 2000 PPM	FS		II	II				Iowa	ALB
		E & A 2 lb.	FS		III	II	II/I	II/I		Idaho	LCE

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Late Season: Dormant	State	Authority
Willow	Salix spp.(Contd.)	Ester or amine	FS/CS	I	I	II	II	II		Man.	HEW
		Ester 2000 PPM	FS		I	I	I			Colo.	EAL
		1100-3300 PPM	FS		II	II	I	I	II	USFS	PJZ
		E & A 2000 PPM	FS	I	I	II	II	II	II	Ill.	S&F
Willow, Black	Salix nigra	Conc. E. & S.	FS	I	II	II	I	I	III	A&T	TVA
		Esters 2000 PPM	FS	II	II	II	II	CS-III		Okla.	HME
		Esters 3000 PPM	FS	I	I	I	II	II		Pa.	FAA
Willow, broad leaf		Iso. Ester 375 PPM	FS			III				Ore.	WCB
Willow Ditchbank	Salix spp.	Esters .2%	FS		II	II				Alta.	JJS
		Ester 10 cc/90 Ker.	CS		III	IV				Alta.	JJS
		Amine .2%	FS		II	II				Alta.	JJS
Willow, Glaucous	Salix bebbiana	Ester 1½ lb.	FS		III	III				Man.	HEW
Willow, narrow leaf		Iso.Ester 375 PPM	FS			I				Ore.	WCB
Wolf berry (See Buckbrush)	Symphoricarpos occidentalis	But.Ester 1000 PPM	FS			II	II			Iowa	EPS
Wormwood, purple stem	Artemissia dracunculoides		FS	I		I				Sask.	HAF

REACTIONS OF WOODY PLANTS TO 2,4,5-T

Common Name	Scientific Name	Formulations and Concentrations 2,4,5-T	Type of Treatment	Type of Reaction According to Season and State of Growth: Early Season: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Late Season: No Succ. Growth	Late Season: Pre-dormant	State	Authority
Alder, speckled	Alnus incana	Na salt 0.875 lbs.	FS				III		Minn.	EAJ
		1000-2000 PPM	FS			II			USFS	PJZ
		I.Ester 1000 PPM	FS			I			Mich.	MWD
		Ester 100/200 PPM	FS	I	II	II			USFS	JHS
Ash, White	Fraxinus americana	Esters 1500 PPM	FS	III	III	III	III	IV	Pa.	FAA
Aspen (See white poplar)										
Birch	Betula papyrifera	1000-2000 PPM	FS			II			USFS	PJZ
Blackberry	Rubus spp.	Conc. E. & S. Iso.Ester 4 lbs. per A. 160 gal. per A.	FS			I	I		A&T	TVA
			FS				I		Idaho	LCE
Blackberry, wild	Rubus allegheniensis	Esters, 1500	FS	I	II	I	II	II	Pa.	FAA
Briers (See Rasp. and Blackberries)	Rubus spp.	I. Ester 1000 PPM	FS					I	Mo.	LVS
Buckbrush	Symphoricarpos orbiculatus	I. Ester 2000 PPM	FS					III	Mo.	LVS
		I. Ester 2000 PPM	FS	I	I	I	I		Okla.	HME
		Ester 2000 PPM	FS		II	II	III		Kan.	Z&M
	Symphoricarpos spp.	3000 PPM	FS	I	I	I	I		Ill.	S&F
		I. Ester 2000 PPM	FS		III				Mich.	C&D
Cedar, Red	Juniperus virginiana	I. Ester 2000 PPM	FS	IV	IV	IV	IV		Okla.	HME
Cherry, Choke	Prunus virginiana	1000-2000 PPM	FS			II			USFS	PJZ
Cherry, Pin	Prunus pennsylvanica	1000-2000 PPM	FS			I			USFS	PJZ
Cherry, Wild	Prunus serotina	I. Ester 2000 PPM	FS					II	Mo.	LVS
		Esters 1500 PPM	FS	I	I	I	I	II	Pa.	FAA
Currant, Alpine	Ribes montigenum	Ester 2000/ PPM	FS	I	I				C Etal	HRO
Currant, Prickly	Ribes lacustre	E & A 2000/ PPM	FS	I	I	I	II	II	C Etal	HRO

Common Name	Scientific Name	Formulations and Concentrations 2,4,5-T	Type of Treatment	Type of Reaction According to Season and State of Growth					State	Authority
				Early Season: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant		
Currant, Squaw	Ribes cereum	Ester 2000/ PPM	FS	I	II	II			C Etal	HRO
Currant, Sticky	Ribes viscosissimum	E & A 2000/ PPM	FS	I	II	II	II	II	C Etal	HRO
Currant, Stink	Ribes bracteosum	E & A 500/ PPM	FS	I	I	I	II	II	C Etal	HRO
Currant, West.Bl.	Ribes petiolare	E & A 500/ PPM	FS	I	I	I	II	II	C Etal	HRO
Dewberry	Rubus spp.	Conc. E. & S.	FS			I	I		A&T	TVA
Elm, American	Ulmus americana	I.Ester 1000 PPM	FS					I	Mo.	LVS
		I.Ester 2000 PPM	FS	II	II	II	II		Okla.	HME
		Ester 1500 PPM	FS	I	I	I	II	II	Pa.	FAA
Elm, Chinese	Ulmus pumila	S & E 1000 PPM	FS	II	III	III	III	IV	Nebr.	GV
		Eth.Ester 9.6%	CS		II	II			Nebr.	GV
Elm, Winged	Ulmus alata	I.Ester 2000 PPM	FS	II	II	II	II		Okla.	HME
Fir, balsam	Abies balsamea	NA salt 0.875 lbs.	FS				III		Minn.	RAJ
		I.Ester 1000 PPM	FS			II			Mich.	MWD
Gooseberry, Gummy	Ribes lobbii	Amine 2000/ PPM	FS	I	II	II			C Etal	HRO
Groseberry, Sier.Nev.	Ribes nevadense	Amine 2000/ PPM	FS	I	II	II			C Etal	HRO
	Ribes roezli	Ester 2000/ PPM	FS	I	II	II	II		C Etal	HRO
Gooseberry, Siskiyou	Ribes binominatum	E & A 2000/ PPM	FS	I	I	I	II		C Etal	HRO
Grape, Wild	Vitus vulpina	Eth.Ester 9.6%	CS		I				Nebr.	GV
		I.Ester 2000 PPM	FS					I	Mo.	LVS
Hackberry	Celtic occidentalis	Eth.Ester 9.6%	CS		III	III			Nebr.	GV
		I.Ester 2000 PPM	FS	II	II	II	II		Okla.	HME
Hawthorn	Crataegus spp.	Esters 1500 PPM	FS	II	II	II	III	III	Pa.	FAA
		I.Ester 1000 PPM	FS			III			Mich.	MWD
Hazelnut	Corylus americana	1000-2000 PPM	FS			I			USFS	PJZ
Hazelnut, Beaked	Corylus rostrata	Iso.Ester .825 lbs.	FS				III		Minn.	RAJ
		Na salt 0.875 lbs.	FS					II-III	Minn.	RAJ
Hickory	Hicoria buckeyi	I.Ester 2000 PPM	FS	II	II	II	II		Okla.	HME
Hickory	Hiccria sp.		FS			II	II		Iowa	EPS
Honeysuckle	Lonicera japonica	Conc. E. & S.	FS			I	I		A&T	TVA

Common Name	Scientific Name	Formulations and Concentrations 2,4,5-T	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Late Season: Dormant	State	Authority
Ivy, Poison	Rhus toxicodendron	I.Ester 1000 PPM	FS					I		Mo.	LVS
		3000 PPM	FS	I	I	I	I	I		Ill.	S&F
		Esters 1500 PPM	FS	I	I	I	I	II		Pa.	FAA
		Conc.	FS		I	I	I	II	IV	Ohio	WJG
		I.Ester 2000 PPM	FS		II	II	II			Mich.	C&D
Juneberry	Amelanchier sp.	1000-2000 PPM	FS			I				USFS	PJZ
Locust, Black	Robinea pseudoacacia	I.Ester 2000 PPM	FS	I	I	I	I	AG-I		Okla.	HME
		Esters 1500 PPM	FS	I	I	I	II	II		Pa.	FAA
Locust, Honey	Gleditzia triacanthes	I.Ester 2000 PPM	FS	I	I	I	I	AG-I		Okla.	HME
Maple, Red	Acer rubrum	I.Ester 1000 PPM	FS			III				Mich.	MWD
Maple, Soft	Acer saccharinum	I.Ester 1000 PPM	FS					I		Mo.	LVS
Maple, Sugar	Acer saccharum	Esters 1500 PPM	FS	III	III	III	III	IV		Pa.	FAA
Mesquite	Prosopis juliflora	2000 PPM Diesel oil	FS	III	II	II	III	III	III	Texas	CEF
		5000 PPM Diesel oil	FS	III	II	II	III	III	III	Texas	CEF
		10000 PPM Diesel oil	FS	III	II	II	III	III	III	Texas	CEF
		25000 PPM Diesel oil	FS	III	II	II	III	III	III	Texas	CEF
		2000 PPM Water	FS	III	III	III	III	III	IV	Texas	CEF
		5000 PPM Water	FS	III	II	II	III	III	IV	Texas	CEF
		10000 PPM Water	FS	III	II	II	III	III	III	Texas	CEF
		25000 PPM Water	FS	III	II	II	III	III	III	Texas	CEF
		2.5% Diesel oil	CS	III	II	II	III	III	III	Texas	CEF
		5.0% Diesel oil	CS	III	II	II	III	III	III	Texas	CEF
		10% Diesel oil	CS	III	II	II	III	III	III	Texas	CEF
		15% Diesel oil	CS	III	II	II	III	III	III	Texas	CEF
		2.5% Water	CS	III	III	III	III	III	III	Texas	CEF
		5.0% Water	CS	III	II	II	III	III	III	Texas	CEF
		10.0% Water	CS	III	II	II	III	III	III	Texas	CEF
		15. % Water	CS	III	II	II	III	III	III	Texas	CEF

Common Name	Scientific Name	Formulations and Concentrations 2,4,5-T	Type of Treatment	Type of Reaction According to Season and State of Growth					State	Authority
				Early Season: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant		
Oak	Quercus spp.	1000-2000 PPM	FS			II			USFS	PJZ
Oaks	Quercus spp.	I.Ester 2000 PPM	FS					III	Mo.	LVS
Oak, Black Jack	Quercus marilandica	I.Ester 2000 PPM	FS	II	II	II	II	AG-II	Okla.	HME
Oak, bur	Quercus macrocarpa	Dow form.	FS			II	II		Iowa	EPS
Oak, Dwarf Chinq.	Quercus muhlenbergii	I.Ester 2000 PPM	FS	II	II	II	II		Okla.	HME
Oak, Post	Quercus stellata	I.Ester 2000 PPM	FS	II	II	II	II	AG-II	Okla.	HME
Oak, Red	Quercus borealis maxima	I.Ester 1000 PPM	FS			III			Mich.	MWD
Oak, shin	Quercus havardi	Conc.Iso.Est. of 2,4,5-T applied @ 1,2,3, lbs.per A.	FS		Defol.				Okla.	EHM
Oak, White	Quercus alba	Esters 1500 PPM	FS	I	I	I	II	II	Pa.	FAA
Osage orange	Maclura pomifera	Dir.acc.to Dow Chemical	FS			II	II		Iowa	EPS
		I.Ester 2000 PPM	FS	IV	IV	IV	IV		Okla.	HME
		Ester, 1500 PPM	FS	I	II	II	II	II	Pa.	FAA
		Ester, 2000/4000P	CS			I	I		Kan.	Z&M
Papaw	Asimina triloba	I.Ester 3000 PPM	FS			III			Mich.	C&D
Persimmon	Diospyros virginiana	I.Ester 2000 PPM	FS	II	II	II	II		Okla.	HME
Pine, Jack	Pinus banksiana	Iso.Ester .825 lbs.	FS				III		Minn.	RAJ
Pine, Red	Pinus resinosa	Iso.Ester .825 lb.	FS				III		Minn.	RAJ
Pine, white	Pinus strobus	Iso.Ester .825 lb.	FS				III		Minn.	RAJ
Plum, Sand	Prunus angustifolia	I.Ester 2000 PPM	FS	I	I	I	I		Okla.	HME
Poplar, white	Populus tremuloides	1000-2000 PPM	FS			I			USFS	PJZ
Raspberry	Rubus spp.	1000-2000 PPM	FS			IV			USFS	PJZ
Rose, Prairie	Rosa arkansana	I.Ester 2 lb.	FS				III		Alta.	JSS
		Amine 2 lb.	FS				IV		Alta.	JSS
Rose	Rosa spp.	1000-2000 PPM	FS			III			USFS	PJZ

Common Name	Scientific Name	Formulations and Concentrations 2,4,5-T	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Late Season: Dormant	State	Authority
Sagebrush, sand	Artemisia filifolia	Conc. Iso. Est. of 2,4,5-T applied @ 1,2,3 lbs. per A.	FS		Defol.					Okla.	EHM
Sassafras	Sassafras albidum	I. Ester 1000 PPM	FS					I		Mo.	LVS
		Esters 1500 PPM	FS	I	I	I	I	II		Pa.	FAA
Skunk brush	Rhus trilobata	Ester 1500 PPM	FS		I	I-II	II			Kan.	Z&M
Spruce, white	Picea glauca	Na salt 0.875 lbs.	FS				III			Minn.	RAJ
Sumac, smooth	Rhus glabra	I. Ester 1000 PPM	FS					I		Mo.	LVS
		I. Ester 2000 PPM	FS	I	I	I	I			Okla.	HME
Sumac, Staghorn	Rhus typhina	Esters 1500 PPM	FS	I	I	I	I	I		Pa.	FAA
Sycamore	Platanus occidentalis	Conc. E.& S.	FS				I	I		A&T	TVA
Tamarack	Larix laricina	Iso. Ester .825 lb.	FS				III			Minn.	RAJ
Trumpet vine	Campsis radicans	Conc. E. & S.	FS				I	I		A&T	TVA
		I. Ester 1000 PPM	FS					I		Mo.	LVS
Tung	Aluerites fordii	I. Ester 3000 PPM	FS	I						Miss.	OAL
Waahoo (Burning Bush)	Euonymus purpureus	I. Ester 2000 PPM	FS					II		Mo.	LVS
Willow	Salix spp.	Na salt 0.875 lbs.	FS				III			Mim.	RAJ
		1000-2000 PPM	FS			I				USFS	PJZ
Willow, Black	Salix nigra	Conc. E. & S.	FS				I	I		A&T	TVA
		I. Ester 2000 PPM	FS	II	II	II	II			Okla.	HME
Willow, Bright	Salix lasiandra	1500 PPM Amines	FS	I	I	I				Colo.	TLS

REACTIONS OF WOODY PLANTS TO THE COMBINATION OF 50% 2,4,5-T AND 50% 2,4-D APPLIED AS FOLIAGE SPRAYS (FS) WITH A CONCENTRATION OF 3000 P.P.M.

SUBMITTED BY F. A. Ashbaugh,
West Penn Power Company
Pittsburgh, Pennsylvania

Common Name	Scientific Name	Type of Reaction According to Season and Stage of Growth				
		Young Seedlings	Early Season: Growth: Succ.	Mid-Season: Growth: Succ.	Late Season: No Succ. Growth	Pre-Dormant
Apple, common	Pyrus malus	III	IV	IV	IV	IV
Apple, American crab	Pyrus coronaria	I	I	I	I	II
Ash, white	Fraxinus americana	III	III	III	III	IV
Aspen, trembling	Populus tremuloides	I	I	I	II	II
Basswood	Tilia americana	IV	IV	IV	IV	IV
Beech, American	Fagus grandifolia	III	III	III	III	III
Birch, white	Betula alba	II	II	II	II	II
Bittersweet, climbing	Celastrus scandens	IV	IV	IV	IV	IV
Blackberry, wild	Rubus allegheniensis	I	I	I	I	I
Briar, common green	Smilax rotundifolia	II	III	III	IV	IV
Cedar, red	Juniperus virginiana	IV	IV	IV	IV	IV
Cherry, choke	Prunus virginiana	I	I	I	I	I
Cherry, fire	Prunus pennsylvanica	I	I	I	I	I
Cherry, wild black	Prunus serotina	I	I	I	I	I
Chestnut	Castanea dentata	II	II	II	II	II
Dewberry	Rubus villosus	II	III	III	III	III
Dogbane		II	II	II	II	II
Dogwood, flowering	Cornus florida	I	II	II	II	III
Elder, common	Sambucus canadensis	II	II	II	II	II
Elm, American	Ulmus americana	I	I	I	I	II
Grape, wild	Vitis sp.	I	I	I	I	I
Hawthorn	Crataegus sp.	II	II	II	III	III
Hercules Club	Aralia spinosa	III	III	III	III	III
Hickory, shellbark	Carya ovata	I	II	II	II	?
Honeysuckle, Japanese	Lonicara japonica	II	II	II	II	II
Ivy, poison	Rhus toxicodendron	I	I	I	I	II
Laurel	Kalimia sp.	IV	IV	IV	IV	IV
Locust, common	Robinia pseudo-accacia	I	I	I	II	II
Maple, ash-leaved	Acer negundo	I	I	I	I	I
Maple, red	Acer rubrum	II	II	II	II	III
Maple, striped	Acer pennsylvanicum	II	II	III	III	III
Maple, sugar	Acer saccharum	II	II	II	III	III
Oak, laurel	Quercus imbricaria	II	II	II	III	III
Oak, red	Quercus rubra	I	II	II	II	?
Oak, white	Quercus alba	I	II	II	II	?
Osage, orange	Maclura pomifera	I	I	I	I	II
Pine	Pinus alba	II	II	III		III
Pine, red	Pinus resinosa	II	II	II		III
Poplar, Carolina	Populus deltoides	I	II	II	II	III
Raspberry, black	Rubus occidentalis	I	I	I	I	I
Sassafras	Sassafras variifolium	I	I	I	I	I
Spice bush	Benzoin aestivale	I	I	I	I	I

(Contd.)

Common Name	Scientific Name	Type of Reaction According to Season and Stage of Growth				
		Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-Dormant
Sumac, staghorn	Rhus typhina	I	I	I	I	I
Sycamore	Platanus occidentalis	I	II	II	II	II
Tree of Heaven	Ailanthus glandulosa	I	I	I	II	II
Tulip tree	Liriodendron tulipifera	I	I	I	II	II
Virginia Creeper	Psedera quinquefolia	II	II	II	II	II
Walnut, black	Juglans nigra	I	II	II	II	?
Walnut, white	Juglans cinerea	I	II	II	II	II
Willow, black	Salix nigra	I	I	I	I	II

RESULTS OF THE USE OF COMBINATION FOLIAGE SPRAYS CONSISTING OF EQUAL PARTS (1500 P.P.M.?) OF 2,4-D AND 2,4,5-T

A SUMMARY SUBMITTED BY W. A. Bodwell,
Public Service Co. of New Hampshire
Manchester, New Hampshire

Common Name	Type of Reaction According to Season and Stage of Growth			
	Young Seedlings	Early Season Growth Succ.	Mid-Season Growth Succ.	Mid-Season No Succ. Growth
Apple			I	I
Arrowwood			I	I
Ash			II	II
Aspen, quaking			I	I
Bayberry			I	I
Briers			I	I
Cherry, black			I	I
Cherry, choke			I	I
Cherry, pin or bird			I	I
Dogwood, grey			I	I
Elm, common			I	I
Hardhack			I	I
Honeysuckle, bush			I	I
Honeysuckle, Tartarian			I	I
Ivy, poison			I	I
Juniper, common			II	II
Maple, Red			II	II
Nannyberry			II	II
Oak, red			II	II
Oak, White			I	I
Pine, white			I	I
Rose, wild			I	I
Sumac, smooth			I	I
Willow, pussy			I	I

The foregoing report on woody plant research was assembled and summarized by

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PROJECT VII. INVESTIGATIONS TO DEVELOP NEW HERBICIDES AND APPLICATIONS OF NEW HERBICIDES TO WEED CONTROL.

Newer Herbicides — Project leader. W. C. Dutton

Summaries

Trichloroacetic Acid

Most abstracts do not indicate if usage was on basis of TCA acid equivalent or as salt. Experiments were reported on TCA for the control of several grasses (quack, Johnson, Bermuda, crab, annual blue and other annual grasses) broadleaved weeds, and cactus. Crops or companion plants involved were corn, soy beans, flax, red clover, blue grass, Buffalo grass, red ceder, ponderosa pine, blueberry, raspberry, cherry, peach and asparagus. There are many conflicting results and some that are not easily explainable but there are many very interesting indications.

Quack grass generally showed only temporary effect or stunting with 20 to 30 lb/A. Intermediate dosages of 40 to 60 lb/A have often given marked reduction and there is little evidence of benefit from more than 100 lb. Best time to apply is not clearly indicated but may depend more on water relations than on stage of growth.

Johnson Grass and Bermuda Grass both respond to TCA but Bermuda is probably most easily killed. Best time to apply not definite but probably can be used at many periods if moisture conditions are favorable. 50 lb/A was not satisfactory on Johnson grass but 100 lb. or more gave good results but not complete eradication.

Annual grasses. Crab grass was killed in one test with 8 lb/A but new seedlings appeared after 35 days. Crab and foxtail emergence was seriously affected by 4 lb. used as pre-emergence treatment in clover. Grass weeds of some size in soy beans were little affected by 10 lb/A but 50 lb. gave fair kill. Annual blue grass was killed with 19 lb/A or more. Several other annual grasses fairly well controlled with 10 to 20 lb/A.

Cactus was killed with a wetting spray of 1/2 lb. in 1 gal. of water. Less was ineffective. Rainfall seemed to be a requirement for kill.

Soy beans may be seriously affected by top sprays with as little as 5 lb/A causing curling of leaves and preventing pods from filling and no pods formed at 10 lb. In another test 6 lb. reduced yield and delayed maturity. Pre-emergence treatment of 20 lb. was very hard on soy beans.

Corn, in a pre-emergence treatment, was seriously damaged by 20 lb/A.

Red clover, stand was prevented by as little as 2 lb/A or more as a pre-emergence treatment but 4 lb. had marked effect on emergence of annual grasses.

Flax stand and yield were affected under some conditions by pre-emergence treatment of 6 lb/A or more. 4 and 6 lb/A applied when flax was 3 - 6 in. high, at early bud and full bloom did not affect yield and did not control weeds.

Lima beans were stunted and distorted by 5 lb. TCA as pre-emergence and produced no beans.

Pre-emergence treatments at very low rates may be valuable with some crops.

Fruit trees, ornamental plants and asparagus are apparently very sensitive to TCA. Red cedar, ponderosa pine, cultivated blueberry, black raspberry, cherry, peach and asparagus were all seriously affected by treatments applied to grass near them.

Residual effects in soil of TCA seem to be closely correlated with rainfall. In one test growth of crops was allowed after 30 days when there had been heavy rain. Later in dry weather no growth of crop was made even after 60 days. Another trial showed no residual effect after 60 days with ample rain.

Mode of action is not clearly indicated but there undoubtedly are two effects. 1) a contact action to exposed part of plant and 2) absorption through roots. Contact action does not seem to be important or necessarily a good indicator of final results. Root absorption seems to be important. Material sprayed on tops and immediately washed off (there was no top "burn") to the soil killed quack just as well as where there was severe top "burn". Rainfall to carry it into the soil seems to be necessary but excessive rain may leach out or otherwise weaken action. Residual toxicity appears to be short with heavy rain and longer with dry weather. Nitrogen relations in plant and soil may be important and high calcium content in soil may affect results.

Ammonium and sodium salts of TCA are apparently equal. One exception only was reported. TCA acid in one trial gave same results as salts.

The General conclusion to be drawn from these reports is that TCA undoubtedly is a very important addition to the list of herbicides but it is equally obvious that much work needs to be done with it in order to definitely establish its possibilities, limitations and best methods of use.

Isopropyl N-phenylcarbamate

IPC applied to exposed rhizomes of quack grass gave no reduction in stand. Other treatments on quack of 15, 30, 60 and 120 lb/A gave some temporary effect only with 120 lb. Crab grass growing in blue grass was not affected by 10 lb/A. Pre-emergence applications of IPC look very promising for control of germinating grasses. 2 lb/A permitted good stand of red clover and controlled

crab and foxtail, 20 lb/A gave weed control without injury in soy beans but killed corn. Low rates look promising as pre-emergence treatment for some legumes. Yield and test weight of flax was not affected by 8 lb/A.

Pentachloronphenol

PCP in oil and the sodium salt in water were reported for several experiments, mostly as pre-emergence treatments. Two tests were on emerged plants. One on annual grasses in which PCP in oil gave 90 to 95% kill and the sodium salt was less effective; the other on flax in which PCP in oil gave fair weed control but had some effect on yield and the sodium salt gave only fair control of broad leaved weeds but did not affect yield. Pre-emergence treatments look promising on large seeded crops and potatoes but probably unsafe with small seeded crops. Depth protection is believed to be a safety factor with large seeded crops but there are many variations. In one test it looked good on soy beans but was hard on corn. PCP in oil was better than sodium salt in some work but in others there was no difference indicated. PCP gave excellent results in asparagus as a spring treatment before cutting began and when soil was disced after cutting was discontinued.

Oils

Several experiments with various kinds of oils were reported. Of three special oils used on flax one had no ill effects on flax, gave no control of broadleaved weeds and fair control of grasses; two others gave no control of broadleaved weeds, but gave excellent control of grasses, with slight and serious reduction in flax yield. Diesel oil as pre-emergence treatment on onions gave about 50% reduction of weeds without injury and as a pre-emergence treatment in certain chemurgic crops gave no weed control and no injury.

2,4,5-Trichlorophenoxyacetic Acid

2,4,5-T, in some form was used for the control of poison ivy, stumps of trees, clover, leafy spurge and purslane and for weed control in onions, corn, oats, clover and alfalfa. In control studies it gave excellent results on poison ivy and on the cut stumps of several species, completely eradicated white clover in turf, did not give satisfactory results on leafy spurge and only intermediate results on purslane. In crop tolerance and weed control studies pre-emergence treatment did not adversely affect corn and was not equal to 2,4-D for broadleaved weeds in one test and gave poor results in another and on onions weed control was not as good as with 2,4-D. An application when corn was 20 in. high caused less stalk bend than 2,4-D and MCP and did not affect yield; on oats treated at 24 in. height 2,4,5-T did not reduce yield, reduce kernel weight, affect germination or number of spikelets, and when sprayed on clover and alfalfa in oats it reduced the stand of both. 2,4,5-T does not appear to be a "super-active" material for general use but an excellent treatment for some of the plants not well controlled by 2,4-D.

2-Methyl-4-Chlorophenoxyacetic Acid

MCP sprayed on clover and alfalfa in oats reduced the stand of alfalfa and increased the stand of clover; it did not reduce the yield of oats or effect kernel weight, germination or number of spikelets; sprayed on corn it did not affect yield and had caused about same amount of stalk bend as 2,4-D; as a pre-emergence on corn it performed about like 2,4-D and as pre-emergence on onions it reduced stand and gave about same weed control as 2,4-D.

Methyl Bromide

Methyl bromide used as a preplanting treatment to the soil under gas proof coverings gave excellent kill of weed seeds, and plants, nematodes and soil infesting insects.

Xanthogen Disulfide

This material was used in one experiment and excellent results w were reported with potatoes and vegetables crops.

LFN No. 472

Promising results were indicated for this material in the one experiment reported. The active ingredient in LFN was not indicated.

Benzene Hexachloride and Chlordan

These materials were reported for one trial as pre-emergence treatments in corn and soy beans. Neither gave satisfactory results as used in this one test.

PROJECT VII. NEWER HERBICIDES

Abstracts of Results of Individual Cooperators

1 Eradicating quack grass with trichloroacetic acid. Wood, H. E., and J. J. Bourns. Dense rod square plots of quack grass were sprayed from late May until mid-August, with the sodium and ammonium forms of TCA from 108 lbs. per acre to as low as 30 lbs. Only the ammonium form applied above 100 lbs. gave promising results, with the early season treatments showing the best kills. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada)

2 Control of quackgrass with chemicals. Slife, F. W. TCA was applied at 20, 50, 75, and 100 pounds per acre as a foliage spray to established stands of quackgrass (Agropyron repens) in June, 1948. As low as 20 pounds per acre caused some burning of the leaves and stunting of the plants, but one month later, the affect of this rate of treatment was not evident. Results varied at the 50 and 75 pound rates, but in general, they were good, and at 100 pounds, complete control was obtained. IPC was applied at 50, 100, and 200 pounds per acre on quackgrass. It had little or no affect on the grass. IPC also was used in 1947 on quackgrass rhizomes exposed by a field cultivator, but there was no reduction in stand from these applications. (Contribution of Ill. Agr. Exp. Sta.)

3 Effects of various rates and dates of application of TCA in the control of quackgrass (Agropyron repens) at Lamberton, Minnesota in 1947-1948. Stahler, L. M. The ammonium salt of TCA (trichloroacetic acid) was applied at rates of 100, 200, 300 pounds per acre as spray solution; 60 gallons water per acre, on June 1, 1947, when quackgrass was in rapid growth early shooting stage; on July 24, 1947, when ripe and dormant; September 3, 1947, in succulent fall growth; on October 24, 1947 when fall growth was killed by frost. Estimates of kill made in July of 1948 indicated little advantage in rates of application above 100 pounds per acre; complete elimination not being obtained with any rate of application on any date. Applications made in June gave poorest control, those in mid July best control. September applications were near as good as July; October applications only slightly better than those of June. In addition to above data, this investigation indicated an advantage in clipping foliage before treatment as survival was markedly greater for all dates and rates on plot areas where grass was not close grazed. (Contribution of BPIS & AE of U.S.D.A.)

4 Effect of IPC and TCA as herbicides to control quackgrass (Agropyron repens) at Lamberton, Minnesota, 1947-1948. Stahler, L. M. IPC (isopropyl N-phenyl carbamate) as a dry powder at rates of 15, 30, 60, 120 pounds per acre; ammonium TCA, (trichloroacetic acid) at rates of 100, 200, 300, 400 pounds per acre as spray solution were applied to quackgrass in a grazed pasture on June 1, 1947 when grass was in good growth and in early shooting stage. Followed by ample rainfall for grass growth. On October 15, 1947 only the heaviest rate of IPC showed

reductions in quackgrass of 90, 80, 98 and 100% for progressive increments respectively--July of 1948 survival of quackgrass was about equal for all rates of treatment--from 20 to 30% of normal stand. These data indicate that TCA is useful in controlling quackgrass; that 100 pounds per acre followed by retreatments may be more efficient than higher rates of application--400 pounds per acre not giving complete elimination. No residual affect of IPC or TCA applications in this investigation were evident 60 days after treatment. (Contribution of BPIS&AE of U.S.D.A.)

5 Effect of trichloroacetic acid and isopropyl N-phenylcarbamate on quack grass (Agropyron repens). Corns, W. G. Dust treatments using 5,10,15,20 lb. TCA as the sodium salt (Dow H-814) per acre were applied in triplicate at 6 stages of growth of quack-grass grown from sections of rhizomes planted outdoors in crocks at Edmonton during 1948. Ttmts. with 10,15,20 lb. chem. per acre watered into the soil at Stage 1: plants 3" tall, 2 wk. from planting, killed top growth within 1 mo. Ttmts. with 15,20 lb. chem. at Stage 2: plants 9" tall, 1 mo. from planting, killed top growth of majority of plants within 2 mo. from time of application. Ttmt. with 15,20 lb. chem. at Stage 3: plants flowering, resulted in death of top growth of approx. ½ the plants during 2 mo. Ttmts at 3 later stages, 2 weeks apart were ineffective. During late September some new growth appeared in crocks treated at Stages 1 and 2. Similar 1948 applications of TCA on land still heavily infested with A. repens after sod-breaking and repeated cultivation during 1947 caused only slight burning of foliage from 20 lb. chem. per acre. Quack grass in advanced stages of growth treated to compare results from 50,100,200 lb. IPC and of TCA per acre showed no response from IPC and very little effect of TCA. The latter killed young plants of red root pigweed, shepherd's purse and stinkweed growing among the grass. (Contrib. Dept. of Plant Science, University of Alberta, Edmonton.)

6 Control of quackgrass and Johnson grass with trichloroacetates. McCall, G. L. and J. W. Zahnley. Applications of the ammonium and sodium salts of trichloroacetic acid were made to Johnson grass varying from the boot to the bloom stage. The materials were applied at rates of ½, 1 and 2 pounds per square rod both to the tops of the plants and to the soil from which the tops were removed. Control was 98 percent or higher on those plots when the tops were treated with the 1 pound per square rod or more. Control of Johnson grass was much poorer on the plots which had the tops removed before the materials were applied to the soil.

Quackgrass was completely controlled by rates of ammonium and sodium trichloroacetate of 100 pounds per acre under favorable conditions. It may be possible that lower rates will be effective. (Contribution of the Kansas Agricultural Experiment Station.)

7 Effect of ammonium and sodium trichloroacetate on Johnson grass and Bermuda grass. Elder, W. C. Ammonium and sodium TCA were applied on Bermuda grass and Johnson grass at monthly intervals during the growing season at the rate of 50, 100, 150

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and 200 pounds of active ingredients per acre. Each treatment was duplicated and each chemical was applied in water at the rate of 100 gallons per acre. Bermuda grass was treated when 1 to 2 inches high, and Johnson grass was treated at several stages - from closely mowed to grass 18 inches high. Unsatisfactory kills were received from all treatments made on Bermuda grass in May and June, but the July and August applications gave complete kills. One replication of all treatments was spaded and planted to several farm crops 30 days after treatment. May and June treated plots produced normal crop growth 30 days after treatment, but the July and August treatments would not allow crops to make normal growth 60 days after applications. Excessive rainfall in May and June may or may not explain the poor kills on Bermuda grass for these months, while good results were received from July and August treatments when rainfall was much less. Some Johnson grass recovered from all treatments. The 50 pound per acre treatment was not satisfactory for Johnson grass. All treatments of 100 pounds per acre or above gave 90% or more kill for May, June and July. All August treatments on Johnson grass gave less than 75% control. TCA gave best results when applied on grass 12-18 inches high. It is too early to take readings for the 1948 September and October treatments. Very good results were received in 1947 for these months on Bermuda grass, but they were unsatisfactory on Johnson grass. No difference could be noticed in the results between the ammonium and the sodium trichloroacetate when used at the same rate. (Okla. Agri. Exp. Sta.)

8 <u>The effect of TCA on Bermuda grass, Buffalo grass, and red cedar trees</u>. Phillips, W. M. Ammonium and sodium TCA were applied at the rate of 3/8 lbs. per 100 sq. ft. (164 lbs. per acre) on numerous patches of Bermuda grass present in the Buffalo grass lawn on the Ft. Hays Experiment Station. The applications were made on June 9 when the soil was wet. A total of 5.84 inches of rain fell between June 9 and June 30. Four days was the longest period without rain. Observations made throughout the summer indicate that the top growth died but growth had resumed on all plots in about four weeks. By the end of the growing season it was evident that the Bermuda grass was fully as vigorous as the unsprayed plots, while the Buffalo grass present had been completely killed. Two of the plots were located in close proximity with red cedar trees about 15 years old. Three of the trees were badly injured by the chemical. The injury became apparent about 5 weeks after spraying. About 75% of the needles died and dropped off, giving the trees a brown, dead appearance. The branches and central leader drooped badly, causing the trees to appear wilted. Later in the season some new growth was evident, indicating at least partial recovery. A Pondorosa pine tree sprayed about the base in 1947 appeared in the fall of 1948 to be similarly effected. (Contribution of Bureau of Plant Industry, Soils and Agricultural Engineering, Division of Cereal Crops and Diseases, Hays, Kansas.)

9 <u>Effect of isopropyl-n-phenyl carbamate and the trichloroacetates upon crabgrass in bluegrass lawns</u>. McCall, G. L. and J.W. Zahnley. Two wettable powders and one oil formulation of IPC were applied in water to bluegrass infested with crabgrass.

The materials were applied at 2, 4, 6, 8, and 10 pounds per acre of the active ingredient. Ammonium and sodium trichloroacetate were applied at the rates of 2, 4, 6, 8, 10 and 20 pounds per acre of the active material. A period of 6 weeks elapsed between the time of treatment and the time counts were made during which 5.37 inches of rain fell. At the time of counting the IPC formulations had had no effect on the crabgrass. TCA formulations at rates of 8 lbs. per acre and above had killed the original stand of crabgrass but after 35 days were allowing new crabgrass seedlings to sprout. Dosages of this magnitude had also injured the bluegrass. (Contribution of the Kansas Agricultural Experiment Station.)

10 Spraying soybeans - TCA. Slife, F. W. and R. F. Fuelleman. TCA was applied to Richland soybeans at the rates of 5, 10, and 50 pounds per acre. The soybeans were 24 inches tall and were infested heavily with grass weeds, mostly foxtail (Setaria sp.) Soybean plants in all plots were severely affected. At the 5 pound rates the leaves remained curled throughout the growing season but pods were formed, although for the most part they were not filled. At the 10 pound rates, no pods formed and the leaves were severely curled. At the 50 pound rates, all the leaves dropped off one week after application.

The two lighter rates had little affect on the grass weeds, but at the 50 pound rate, a fair measure of control was obtained. (Contribution of Ill. Agr. Exp. Sta.)

11 Effect of IPC and TCA, pre-emergence, on red clover, Columbus, Ohio. Shaw, Warren C. and C. J. Willard. Red clover was sown April 21 in rows 28 inches apart and 15' long, in a randomized block with four replications. The sodium salt of TCA, the ammonium salt of TCA, and IPC were applied at 0, 2, 4, 8, and 16 pounds per acre. The TCA salts were applied in 5 gallons of water per acre, the IPC in 100 gallons per acre. All rates of TCA prevented growth of red clover. Four pounds of either salt prevented establishment of crabgrass and foxtail. Even 2 pounds had considerable effect. Two pounds IPC almost completely prevented establishment of crabgrass and foxtail, and permitted a good stand of clover. Some clover survived even 16 pounds IPC and fair stands 8 pounds. (Contribution from Ohio Agr. Exp. Station)

12 Cactus control by the use of trichloroacetates. McCall, G. L. and J. W. Zahnley. Ammonium and sodium trichloroacetate were applied to cactus, Opuntia humifusa, in July 1947 during a severe drouth period. Concentrations used were 3/4#, ½# and 3/8# per gallon of water. Plants were sprayed to the run-off point. The plant response was small until rains occured when plants began to show severe damage. Stands were nearly eradicated by 3/4# and ½# treatments but a few small spot treatments were necessary to complete the clean up. 3/8# per gallon of the trichloroacetates did not give satisfactory control. (Contribution of the Kansas Agricultural Experiment Station)

13 The effect of new chemicals on corn and soybeans when applied as pre-emergence sprays. Shaw, Warren C. and C. J. Willard. Corn and soybeans were sown in alternate rows, 20 inches apart, 200 feet long. Each plot consisted of 2 rows of each. The treatments were not replicated. All chemicals were applied as pre-emergence sprays in 100 gallons of water/A Aug. 17, 1948, immediately after planting. The following chemicals were applied at the following rates per acre: IPC, 20, 40, and 80 pounds; TCA, sodium salt, 20, 40, and 80 pounds; TCA, ammonium salt, 20, 40, and 80 pounds; 40 pounds IPC plus 2 pounds 2,4-D (acid equivalent) as the triethanolamine; 40 pounds TCA as the ammonium and as the sodium salt, plus 2 lbs. 2,4-D with each; sodium PCP 30 pounds; benzene hexachloride 5 and 15 pounds; PCP in oil 20, 30, and 40 pounds; chlordane, 10, 30, and 90 pounds; isopropyl ester of 2,4,5-T 2 pounds acid equivalent; DNOSBP 10 pounds. The weed population in this experiment consisted chiefly of quackgrass, green foxtail, crabgrass, rough pigweed, lamb's quarter. Satisfactory stands of soybeans with good to perfect weed control were obtained with 20 pounds PCP, 20 pounds IPC, and 10 pounds DNOSBP. Corn was killed or severely injured by all of these. TCA (either salt) gave excellent control of all weeds at 20 pounds - some quackgrass shoots are appearing November 1, but not on 40 and 80 pound rates, but corn and soybeans were severely affected by the lowest rate used (20 lb.). Lower rates of IPC and TCA are worth trying on legumes pre-emergence for control of weedy annual grasses. PCP is worth more extended trials on soybeans. The other chemicals gave little promise for this use in this one test. (Contribution from Ohio Agr. Exp. Station.)

14 Trichloroacetic acid, sodium salt, applied for the control of annual blue grass (Poa annua) and quack-grass (Agropyron repens) growing in certain horticultural crops. Davidson, J. H. and L. L. Coulter. During 1948 sprays containing TCA sodium salt were applied at rates of 19, 37 and 74 pounds TCA equivalent in 300 gallons water per acre. These treatments were used alone and in combination with 0.5 lb. and 1 lb. of 2,4-D sodium salt per acre. Two series of treatments were made, the first in mid-April the second, one month later. The treated grass plots included blueberry, black raspberry, peach and cherry. All treatments gave good control of Poa annua in the blueberry planting. The higher concentrations were necessary for quack-grass control. Chlorosis and some marginal leaf necrosis was noted on all crops at the concentrations used. Severity of the injury increased with the higher concentrations. Injury did not become apparent in all cases until two months after application. Inclusion of 2,4-D did not affect the degree of control or the amount of injury. On asparagus 62, 124 and 248 lbs. TCA equivalent per acre resulted in good quack-grass control but injured the asparagus. (Contribution of The Dow Chemical Co., South Haven, Mich.)

15 Field studies on the physiology of TCA as an herbicide for the control of quack grass and blue grass. Barrons, Keith C. Plots receiving equal sprays with one immediately washed with water resulted in equal grass effect after three weeks even though severe top "burn" occurred on the unwashed plot while

none occurred where TCA was washed from the foliage. Independence of the frequently observed contact action and the systemic effect resulting in retardation or killing of the grass is thus indicated and root absorption is shown to be the important avenue of entry. Equal effects from spraying closely mowed and unmowed grass and the roots of upturned sod indicate further the importance of root absorption. TCA acid and the sodium and ammonium salts appear equally effective. They are compatible with phenoxyacetic acids and phenolic contact herbicides. The latter observation further indicates the lack of significant foliage absorption. 10 lb/A of sodium TCA has given significant grass retardation over a considerable period while 40 lb/A appears to be an approximate minimum dose for significant kill. Soil moisture appears to be a critical factor. Inferior results on high nitrate soils indicate a possible internal or external nitrogen relationship. Inferior results on calcareous soils indicate possible fixation as the less soluble calcium or magnesium salts. (Contribution of The Dow Chemical Co., South Haven, Mich.)

16 Effects of 2,4-D, TCA, IPC, and Contact dinitro on the yields and test weight of flax when applied as pre-emergence sprays. Derscheid, Lyle A., L. M. Stahler, and D. E. Kratochvil. Randomized plots of Dakota flax one rod long and seven feet wide were treated in triplicate at seeding time and three days later (one day before flax emerged) with 1, 2, and 4 lbs. of 2,4-D acid per acre, as triethanol amine salt; 6, 12, and 24 pounds of TCA acid per acre, as ammonium salt, 2, 4 and 8 pounds of IPC per acre and 1, 2, and 4 pounds of dinitro-o-sec-amylphenol per acre, applications at seeding time were made in forenoon and three tenths of an inch of rain fell that night. Stands of flax, on plots treated at seeding time, were reduced 50, 30 and 20 per cent by 4, 2 and 1 pounds of 2,4-D; 40, 25 and 15 per cent by 24, 12 and 6 pounds of TCA and 30, 20 and 10 per cent by 8, 4 and 2 pounds of IPC respectively. These thin stands were not noticeable at harvest. An analysis of variance indicates that test weight of the flax was not affected by these treatments and that significant changes in yield due to treatment with 2,4-D, IPC or dinitro were not established. All rates of TCA applied at seeding time reduced the yield of flax significantly; whereas, only the two higher rates reduced yields when applied just prior to emergence. Foxtails (Setaria spp.) were satisfactorily controlled by TCA while common ragweed (Ambrosia artemisifolia) Kochia (Kochia scoparia) were controlled by all rates of 2,4-D applied on the later date. (Contributed by the Agronomy Dept. of the South Dakota Agr., Exp. Sta. and the Bureau of Plant Industry, Soils and Agr. Engineering, U.S.D.A.)

17 Effects of TCA, 2,4-D and selective dinitro on the yields of flax when applied to three different growth stages. Derscheid, Lyle A. and D. E. Kratochvil. Square rod plots of Dakota flax that was lightly infested with lamb's quarters (Chenopodium album), rough pigweed (Amaranthus retroflexus), common ragweed (Ambrosia artemisifolia), Kochia (Kochia scoparia), foxtails (Setaria viridis and glauca B.) and some barnyard-grass (Echinochloa Crueguli), was treated in triplicate with 4 and 6 lb/A of the ammonium salt of TCA, ¼ and 3/8 lb/A of the triethanol amine of 2,4-D and 3/4 and 1 lb/A of the ammonium salt of DNOSBP. Treatments were made when the flax was 3 to 6 inches tall, in early bud, and in

full bloom. The dinitro and TCA did not give any weed control but both rates of 2,4-D gave effective control of the broadleaved weeds when applied at the two earlier stages. An analysis of variance indicates that yields from plots treated with 2,4-D were significantly higher than yields from untreated plots or from plots treated with any other chemical: and it also indicates that plots, treated with 2,4-D at the two earlier stages of growth, produced a significantly higher yield than plots treated when in full bloom. The weed control probably accounts for these differences. Significant differences in yields due to treatment with TCA or dinitro at the various stages of growth was not established. (Contributed by the Agronomy Dept. of the South Dakota Agricultural Experiment Station)

18 The effects of 2,4-D and TCA on the yields of nine soybeans varieties and on the weeds in the soybeans. Derscheid, Lyle A. and D. E. Kratochvil. Dup. 16' - 2-row plots with 3.5 ft. spacing of Capital, Hawkeye, Lincoln, Manchukota, Richland, Ottawa Mandarin, Flambeau, Earlyana, and Bavender Special, a farmer selection, were treated with ¼ and ½ lb. 2,4-D acid/A as triethanol amine salt and with 6 and 16 lb. TCA acid/A as ammonium salt when beans had 6 leaves and were 6 to 8" tall. Lamb's quarters, rough pigweed (Amaranthus retroflexus) Kochia (Kochia scoparia) common ragweed, foxtails and barnyard grass were 4 to 6 in. tall. All plots were cultivated three times and rows hand-weeded when beans were 12-16 in. tall at which time weed counts were made. TCA did not control the grasses, but both rates of 2,4-D controlled 50-75% of the broadleaved weeds. 2,4-D stunted the soybeans so badly that grassy weeds outgrew the soybeans. Analysis of variance indicates that yields were changed due to treatment and an L.S.D. indicates that all treated plots produced yields that were significantly lower than those of untreated plots. The interaction "treatments x varieties" produced an "F" value that was significant at 5% level indicating that all varieties did not respond the same and an L.S.D. indicates that the yields of Lincoln, Manchukota, and Bavender Special were not decreased by the application of ¼ lb. 2,4-D acid/A; whereas, all other treatments decreased the yield. Maturity of soybeans was delayed two weeks by 2,4-D and more than 2 weeks by TCA. If frost had occurred as early as usual none of the treated plots would have matured. Results indicate it is hazardous to use 2,4-D or TCA as post-emergence treatments when the beans are 6 to 8 in. tall. (Contr. by the Agronomy Department, South Dakota Agr. Exp. Station)

19 Effect of herbicidal oils, oils fortified with PCP and sodium PCP in water spray on weeds in flax and yield and test weight of flax seed. Stahler, L. M., Lyle A. Derscheid. Triplicated randomized plots of Dakota flax, infested with Setaria spp., Panicum spp., Echinochloa sp; Plovgonum spp. Amaranthus spp. and Ambrosia sp. were sprayed when Flax was 4-6 inches and weeds in seedling stage with Shell Oil Co., ACX 184, ACX 170, ACX 224, various herbicidal oil fractions at 40 and 80 gallons per acre. Shell Oil ACX 238 and 237 containing 1.25 and 2.5% PCP respectively at 40 gallons water per acre and 4 and 8 pounds sodium PCP in 40 gallons water per acre were also used. Oil ACX 184 gave no reduction in yield or test weight of flax; no control on broad-

leaved weeds 25 and 75% control of grass weeds at 40 and 80 gal. respectively. ACX 140 gave no reduction in broad-leaved weeds, excellent control of grassy weeds. Marked reduction in flax yields at both rates; ACX 224 gave equal control of weeds, only slight reductions in yield of flax at higher application rate. Oils fortified with PCP gave fair control of all weeds, reduced yields of flax 50% or more. Sodium PCP in water gave only fair control of broad-leaved weeds, poor control of grassy weeds, no depressions in yield of flax. This investigation indicates that oils, oils fortified with PCP or sodium PCP in water spray cannot as yet be recommended for control of weeds in flax. (Contributed by Bureau of Plant Industry, Soils and Agricultural Engineering of U.S.D.A. and Agronomy Department of South Dakota State College).

20 Residual pre-emergence weed control with phenolic herbicides. Barrons, K.C., W. R. Mullison and L. L. Coulter. Large-seeded crops including corn, peas, various beans, cucurbits, and sunflower tolerated effective residual dosages of PCP and DNOSBP with control of small-seeded weeds providing surface moisture was present. Promising results were obtained with established asparagus treated before first emergence and after discing following final cutting. Depth protection is believed to be the basis of selectivity so other large-seeded and many vegetatively-propagated crops will probably tolerate such a treatment. Emulsifiable formulations of the parent phenols and water solutions of their salts proved successful. 15 to 25 lbs. of PCP or its sodium salt or 5 to 8 lbs. of DNOSBP or its ammonium salt per acre are suggested for trial. For row treatment one third these rates may be used. The preference for one compound over the other has yet to be established under various conditions and with different weeds. Some specificity of reaction between weeds and compounds was observed but to most species, DNOSBP is between 3 and 4 times as toxic as PCP. With quick-emerging crops applications at the time of planting which permits combining the two operations gave as good control as delayed treatment. If a salt formulation is used for delayed application miscible oil should be added to insure contact action on weeds that are already up. (Contribution of The Dow Chemical Co., South Haven, Mich.)

21 Pre-emergence weed control in vegetables. Wilson, J. D., H. E. Bruner, and W. E. Hall. At least 16 of 19 formulations, mostly with PCP, dinitros, and 2,4-D, applied to potatoes just as the first plants were coming up (May 12) gave good control of weeds (chiefly smartweed) which persisted for several weeks in most instances. Sodium PCP in water and DNOSBP in aromatic oil were slightly injurious to potatoes but gave excellent weed control. 2,4-D, sodium salt and amine salt checked weeds effectively, but caused severe leaf deformation, so severe that no normal leaves were produced for 6 weeks. Eight to 12 vegetables were planted in adjacent rows in duplicated plots and sprayed crosswise with 18 to 20 weed-killing formulations just before emergence in experiments started on three different dates. Corn was found to be best able to survive all of the hazards involved in this type of treatment. Snap beans and cucumbers ranked second and third, respectively, in survival power. All three of these possess comparatively large seeds. Tomato, cabbage, carrot, and lettuce were very sensitive to injury in most instances.

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Again the dinitro compounds in oil, sodium PCP in water and various forms of 2,4-D were most injurious to the vegetables but gave good weed control. The best balance between weed control (smartweed, purslane, red root, and shepherd's purse) and vegetable survival was obtained with various formulations of either PCP or Sulfasan (Xanthogen disulfide) in an aromatic oil. (Agri. Experiment Station, Wooster, Ohio)

22 The effect of foliage sprays containing 2,4,5-trichlorophenoxyacetic acid applied at various intervals throughout the summer on poison ivy (Rhus toxicodendron). Davidson, J. H. During 1948 foliage sprays containing 2000 ppm of 2,4,5-T as the isopropyl ester were applied as a wetting spray to separate plots of R. toxicodendron under apple trees. Sprays were applied with a power sprayer at reduced pressures using a nozzle which gave a coarse fan type spray. Applications were made at two weeks intervals throughout the summer commencing June 16 and terminating Aug. 25. All treatments gave complete kill of top growth the current season. No visible injury appeared on apple foliage. Final evaluation of the various treatments will be based on observations and regrowth in 1949. (Contribution of The Dow Chemical Co., South Haven, Mich.)

23 Soil fumigation with methyl bromide for control of weeds and nematodes in seed beds. Dieter, C. E. and L. L. Coulter. Pre-planting application of methyl bromide MC-2 (methyl bromide containing 2% chloropicrin as a warning agent) under a gas-proof covering has shown effective control of weeds and nematodes in seed beds. Methyl bromide at rates of 0.5, 1 and 2 pounds per 100 square feet was used at exposures of 24 and 48 hours, with satisfactory results from all treatments, when the soil was in good seed bed condition. Similar tests applied to very dry soil or to soil saturated in the top level did not give as complete control. There are indications that both dormant and germinating seeds are killed at least in the area above the plow sole. In addition both root knot and the meadow type nematode are also controlled. The methyl bromide was released under the gas-proof covering with a Jiffy applicator attached to a Saran tube. The covering was supported 3-4 inches above the area to be treated and the edges sealed with soil. Methyl bromide is a poisonous gas and should be used with extreme caution. 48 hours should elapse after removal of the tarp before planting the seed bed. (Contribution of The Dow Chemical Co., South Haven, Mich.)

24 Further tests on the control of woody plants by stump treatment with oil solutions of esters of phenoxyacetic acids. Barrons, K. C., and L. L. Coulter. Tests pointing to the value of kerosene and fuel oil as carriers of 2,4-D ester for stump treatment were abstracted in the 1947 proceedings. Further tests show that many species respond to this method and applications may be made at any season. Variable results appear to be related to factors other than season, however further tests on seasonal responses are needed. Tests of light vs. heavy wetting at 4000 and 8000 ppm show that volume is equally as important as concentration. 8000 ppm is considered adequate for most species. Liberal wetting of cut surfaces and surrounding bark is recommended. Small uncut woody growth such as may remain in a brushed-

off area may often be killed by wetting the bark. 2,4,5-T ester appeared sufficiently more effective than 2,4-D ester on some species to warrant its use. Pending further tests on species reaction to the two compounds a mixture of 4000 ppm of each is recommended for mixed vegetation. Because of lower solubility of 2,4,5-T esters finished sprays to be used in cold weather should be made up at room temperature. One stump treatment often results in as great a reduction in regrowth as one foliage application. This method may have a place in new clearing operations or where spray drift hazzards or lack of time prevents treatment during the growing season. (Contribution of The Dow Chemical Co., South Haven, Mich.)

25 The effect of 2,4,5-trichlorophenoxyacetic acid on white and red clover. Coulter, L. L. and K. C. Barrons. White clover growing in turf was virtually eradicated by the application of 1-1/4 lbs. of 2,4,5-T isopropyl ester in the fall of 1947. During the summer of 1948 similar results were obtained, however, some re-growth was observed at rates of one lb. and less. In contrast to 2,4-D which often causes only a temporary chlorosis and some retardation of growth, 2,4,5-T causes severe epinasty on both red and white clover which is quickly followed by death of the plants. 2,4,5-T is promising for white clover eradication on golf courses and other turf areas where this species is considered undesirable. It is apparently as effective on dandelion and plantain as 2,4-D. If 2,4,5-T is used on turf where white clover is desired it should be assumed that this plant will be seriously affected. While 2,4-D shows some possibilities in the selective spraying of red clover, this crop seems to be sensitive to 2,4,5-T. (Contribution of The Dow Chemical Co., South Haven, Mich.)

26 Leafy spurge eradication with 2,4-D and 2,4,5-T. Wood, H. E., and J. J. Bourns. Although extensive trials since 1945 with several formulations of 2,4-D at various rates, dates, and re-treatments on leafy spurge had given little encouragement, field trials on an acreage basis started in 1947, were continued and extended during 1948. In addition to 2,4-D, 2,4,5-T was used, both separately and mixed with 2,4-D. Acreage plots of heavily infested spurge on sandy loam soil treated in mid-July, 1947 (spurge 12 - 24 inches high and setting seed) were noted in early summer 1948 before re-treatment to be delayed in maturity and about 50% thinner in stand than untreated balance of field. Quack grass in competition with the treated spurge had gained headway. On 1948 plots, 2,4,5-T alone, or mixed with 2,4-D, was less effective than the esters of 2,4-D. One series of plots treated with amine were comparable in results to those sprayed with ester. In spring wheat sparsely infested with spurge in flower, excellent control (spurge killed back to the ground) was obtained by as little as 4 ounces acid ester; the same amount 2,4,5-T gave less satisfactory control. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada.)

27 Response of red clover and alfalfa seedlings to growth regulator and dinitro herbicides. Buchholtz, K. P. Seedlings of

medium red clover and Ranger alfalfa growing with Clinton oats as a companion crop were sprayed when the oats was about 24 inches high. The following 2,4-D preparations were applied at the rate of 1 pound of the acid equivalent per acre using 20 gallons of water: (1) ethyl ester, (2) isopropyl ester, (3) butyl ester, (4) sodium salt, (5) ammonium salt, (6) Dow Chemical Co. amine preparation, (7) John C. Powell and Co. amine preparation, (8) American Chemical Paint Co. amine preparation. In addition the isopropyl ester of 2,4,5-trichlorophenoxyacetic acid (9) and the isopropyl ester of 2-methyl, 4-chlorophenoxyacetic acid, (10) were applied at the equivalent of 1 pound of the acid per acre. A 13 per cent preparation of ammonium salt of dinitro-o-sec-butyl phenol was applied at the rate of 1 gal. per acre in the equivalent of 80 (11), 40 (12) and 20 (13) gallons of water. All applications were replicated four times and the data were analyzed statistically. Check stands of red clover and alfalfa averaged 6.6 and 6.8 plants per square foot respectively. Significant reductions in stands of red clover were obtained following applications of (1), (2), (3), (7) and (9). Stands obtained were respectively, 11,30,17,16 and 4 per cent of check for these applications. Plots treated with (10) had significantly better stands than check, being 144 per cent of check. All other treatments were not significantly different from check. Significant alfalfa stand reductions were obtained following applications of (1), (2), (3), (5), (6), (7), (8), (9) and (10), the stands as per cent of check being 3,11,6,67,53,24,23,10, and 13 respectively. The dinitro sprays significantly increased the stands of alfalfa, the stands being 157, 154 and 143 per cent of check for applications (11), (12) and (13) respectively. (Dept. of Agronomy, Univ. of wis., Madison, Wisconsin).

28 <u>Effect of herbicidal applications of growth regulating substances and dinitro materials on the grain yield, seed germination, spikelet number, and kernel weight of oats.</u> Buchholtz, K. P. Clinton oats was treated when approximately 24 inches tall and starting to head with 2,4-D as the ethyl ester (1), isopropyl ester (2), butyl ester (3), sodium salt (4), ammonium salt (5), Dow Chemical Co. amine (6), J. C. Powell and Co. amine (7), and the American Chemical Paint Co. amine (8) at the rate of 1 pound of the acid equivalent per acre using 20 gallons of water per acre. The isopropyl esters of 2,4,5-T (9) and MCP (10) were applied at similar rates. A 13 percent preparation of dinitro-o-sec-butylphenol was applied at the rate of 1 gallon per acre in 80 (11), 40 (12), and 20 (13) gallons of water. All treatments were replicated four times and the data were analyzed statistically. The experimental area was kept essentially weed free throughout the season except for a seeding of red clover and alfalfa. Applications (3), (11), (12), (13), reduced grain yield significantly. Plots receiving these treatments yielded 93.4, 92.7, 67.5 and 64.8 bushels per acre while check yielded 108.2 bushels. None of the other plots yielded significantly different from check. Seed from the treated plots germinated from 91.4 to 97.7 per cent while seed from check plots germinated 97.4 percent. None of the differences are significant. None of the growth substance applications reduced kernel weight significantly but the dinitro applications (11), (12), and (13) reduced kernel weights to 2.36, 2.05 and 1.93 gms. per 100 kernels while check

weighed 26.5 gms. All of these reductions are significant and are thought to be due to severe defoliation produced by these sprays. Average spikelet numbers per panicle were determined for all treatment but none were significantly different from check. (Dept. Agronomy, Univ. of Wis., Madison, Wisconsin.)

29 Effect of several growth regulating materials applied at herbicidal concentrations on corn growth and yield. Buchholtz, K. P. The yellow dent single hybrid R3 x M13 was sprayed when about 20 inches high with the sodium salt (1), amine (2), and butyl ester (3) preparations of 2,4-D and the isopropyl esters of 2,4,5-T (4) and MCP (5). Applications were made at the rates of 0.25, 0.5 and 1.0 pounds per acre using the equivalent of 20 gal. of water as a top spray. All treatments were replicated 4 times and statistical analyses of the data were made. The plots were kept weed free throughout the season. Stalk bending indexes were obtained 4 weeks after treatment. An index of 0 denoted no bending and 5 complete prostration of all plants. Plots treated with (3) had an average bending index of 1.55 which was significantly higher than that obtained with any of the other materials. Material (4) gave an index of 0.70 which was significantly lower than any of the other materials. Materials (1), (2) and (5) gave intermediate indexes of 1.16, 1.22 and 1.20 respectively and were not significantly different from each other. In every case there was an appreciable increase in stalk bending with increases in rate of application. Grain yields of plots treated with materials (1), (2), (3), (4) and (5) averaged 55.2, 54.0, 52.8, 51.3, and 52.5 bushels per acre respectively with check yielding 58.4 bushels. None of these differences obtained were significantly less than check. It appears that corn will develop good yields of grain after being treated with 2,4-D provided that the bent stalks are not broken by cultivation or weather hazards. (Dept. of Agronomy, Univ. of Wisconsin, Madison, Wis.

30 Use of 2,4-D and related materials for pre-emergence weed control in corn. Buchholtz, K. P. Corn plots 20 hills in size were planted with the yellow dent single hybrid R3 x M13 in a Miami silt loam of average fertility. Two days after planting plots were sprayed with the sodium salt of 2,4-D, at the rate of 1, 2 and 4 lb. of the acid equivalent per acre. Additional plots were sprayed at the same time with the butyl ester of 2,4-D and the isopropyl esters of 2,4,5-T and MCP at the rate of 2 pounds per acre. All applications were replicated 4 times and the data were analyzed statistically. The season was exceptionally dry and except for a 1/4 inch shower the surface soil remained dry for several weeks after planting. The corn emergence was not affected by any of the applications. Only partial weed control was obtained. Check plots averaged 7.1 broadleaved leaves per plot. Plots treated with the 1, 2 and 4 lb. applications of the sodium salt and the butyl ester of 2,4-D and the isopropyl esters of 2,4,5-T and MCP averaged 1.9, 1.0, 0.6, 0.8, 2.7 and 0.8 broadleaved weeds per square foot respectively. All of these stands are significantly less than check. The same plots averaged 16.4, 8.6, 4.3, 9.2, 8.4 and 5.9 grassy weeds per square foot while checks averaged 20.2 grassy weeds per square foot. All of these stands are significantly less than check except the 1 pound of sodium salt application. All treated plots had considerable weed growth on them that was allowed to remain

during the remainder of the season. Grain yields of 20.7, 36.1, 40.1, 39.0, 30.0, and 33.4 bushels per acre respectively were obtained. All of these are significantly lower than the clean cultivated check yield of 60.8 bushels per acre. This reduction in grain yield was due to weed competition since plots given pre-emergence treatments but kept clean cultivated approximated the check in yield. (Dept. of Agronomy, Univ. of Wis., Madison, Wisconsin)

31 Effectiveness of several growth regulating substances for controlling the growth of purslane (Portulaca oleracea). Buchholtz, K. P. The sodium salt (1), amine (2), and butyl ester (3) of 2,4-D as well as the isopropyl esters of 2,4,5-T (4) and MCP (5) were applied to purslane seedlings as they were emerging from the soil. Applications were made at the rates of 0.25, 0.5 and 1.0 pounds per acre of the acid equivalent using 20 gal. of water per acre. All treatments were replicated four times and the data were analyzed statistically. Weed counts one month after application showed that some treatments had given excellent control of the purslane. All treatments but the 0.25 and 0.5 pound applications of (1) and the 0.25 pound applications of (2) reduced plant numbers significantly below check. The average weed infestation for plots receiving treatments with (1), (2), (3), (4) and (5) were 15.2, 8.4, 1.3, 3.9 and 5.5 plants per sq. ft. with check plots averaging 19.9 plants. There was no statistical difference between average plant counts obtained with (3), (4) and (5) although (3) gave the lowest plant counts at every rate of application. In this study the 0.25 pound application of (3) was greatly superior to the 1.0 application of (1) and superior to the 1.0 application of (5) and the 0.5 applications of (2) and (4). (Dept. of Agronomy, Univ. of Wisc., Madison, Wis)

32 Effect of four contact herbicides on several species of annual weedy grasses (Digitaria sanguinalis (L.) Scop., Setaria viridis (L.) Beauv., Echinochloa crusgalli (L.) Beauv., and Panicum scribnerianum Nash.). Shafer, N. E. Foliage sprays of ammonium TCA, sodium PCP, PCP, and ammonium sulfamate were applied to square rod plots July 14, 1948. Ammonium TCA and the sodium PCP were applied at rates of 10, 20, and 40 pounds per acre. PCP was used at dilutions of one part phenol to three parts water and one to seven. Ammonium sulfamate was applied at 80, 160, and 320 pounds per acre. Both water and diesel fuel were used as diluents for all materials at all rates. Six weeks after treatment the ammonium TCA at 40 pounds per acre in water and PCP at one to seven in oil gave 90 to 95 per cent kills (average of three replications). All other treatments gave somewhat poorer kills. Ammonium TCA gave the most consistent results with an estimated kill of 75 per cent from both the 10 and 20 pound rates. Poor results were obtained with applications of ammonium TCA, sodium PCP, and ammonium sulfamate in oil because of their low solubility in the oil. The 40 gallons per acre volume of spray was too light to give complete coverage on some of the more densely infested plots. (Contribution of Dept. of Agronomy, Nebraska Agri. Exp. Station, Lincoln, Nebraska.)

33 Pre-emergence treatments of chemurgic crops with eight herbicidal materials. Sand, Paul and N. E. Shafer. Soil applications of ammonium TCA at 25 and 50 lbs., LFN#472 at 1 and 2 lbs., IPC at 7½ and 15 lbs., sodium TCA at 25 and 50 lbs., diesel fuel at 50 and 80 gallons, Sinox General at 1 and 2 lbs., sodium PCP at 4 and 12 lbs., and 2,4-D at 1/2, 1, and 2 lbs. per acre were made June 7, 1948. All rates given are on the per acre basis. Crops treated were sesame, safflower, castor beans, perilla, and sunflower. One row of each crop was planted in plots 10 x 10 feet. Planting was done June 5, 1948. Precipitation following treatment amounted to .12 inches on the fourth day, .23 inches on the fifth day, and a total of 3.85 inches for the 30 days following treatment. Notes on emergence were taken 8 days after planting and on crop damage 5 weeks after planting. Chemicals which show promise and gave good weed control are LFN#472 at 1 lb. per acre and sodium pentachlorophenate at 4 and 12 lbs. per acre. Sesame, sunflower, castor beans, and perilla were not affected by LFN#472. Castor beans, sunflower, and perilla were not affected by sodium PCP at 4 lbs.; however, perilla was affected at the 12 lb. rate. Crops considered seriously affected were badly stunted or burned and looked incapable of complete recovery. Of the other chemicals ammonium and sodium TCA did not control weeds and affected all crops. Sinox General gave good weed control but damaged all crops. Diesel fuel gave no weed control and did not affect crops. IPC gave fair weed control at 15 lbs. per acre. 2,4-D showed good weed control at 1 and 2 lbs. but affected all crops to some extent, the results not being consistent. One-half lb. of 2,4-D did not damage the crops but gave no weed control. (Contribution of Dept. of Agronomy, College of Agri., Lincoln, Nebraska.)

34 Comparison of 2,4-D with contact herbicides for pre-emergence weed control in onions. Warren, G. F. Replicated experiments were conducted on onions seeded approximately one inch deep in peat soil at three locations using Early Yellow Globe at two locations and Brigham Yellow Globe at the other. Just before onion emergence (11 to 15 days after planting), the sodium salt of 2,4-D at 1/2, 1 and 2 pounds of acid equivalent per acre, diesel fuel at 25 and 50 gallons and a 2 per cent solution of Dow Contact Herbicide at 25 and 50 gallons, were applied as sprays to the soil surface. Many weeds were up at this time. Precipitation at all locations during the two weeks following the applications was less than 1 inch. Weed counts were made 5 to 6 weeks after planting and the weeds were removed from all plots at this time and subsequently throughout the season. The average reduction in stands of weeds which included pigweed (*Amaranthus retroflexus*), purslane speedwell (*Veronica peregrina*) and several species of annual grasses was 61, 70, and 77 per cent respectively for 1/2, 1 and 2 pounds of 2,4-D. Diesel fuel reduced the number by 46 and 54 per cent and Dow Contact by 36 and 57 per cent for the 25 and 50 gallon rates respectively. Purslane (*Portulaca oleracea*) was present in one of the experiments but none of it had emerged when the treatments were applied. Excellent control of this weed was obtained with 2,4-D whereas the contact herbicides, i. e., diesel fuel and Dow Contact, gave practically no control. In the latter experiment there was no apparent injury to the onions from any of the treatments but at the other two locations Dow Contact at 50 gal-

lons per acre caused over 35 per cent reductions in the stand of onions and smaller reductions in yield. The stand and yield was not reduced by any other treatment at any of the locations. (Dept. of Horticulture, Univ. of Wisconsin, Madison, Wis.)

35 Comparison of three 2,4-D formulations with other growth regulators for pre-emergence weed control in onions. Warren, G. F. A replicated experiment was conducted on Brigham Yellow Globe onions planted approximately one inch deep in peat soil. Eleven days after planting, the sodium salt, amine salt and butyl ester of 2,4-D and amine salts of MCP and 2,4,5-T were applied as aqueous sprays to the soil surface at the rates of 1 and 2 pounds of acid equivalent per acre. Precipitation during the two weeks following the applications was .86 inches. Weed counts were made 5 and 8 weeks after planting and the weeds were removed from all plots at these times and subsequently throughout the season. The average reduction in stand of weeds 5 weeks after planting which were primarily pigweed (Amaranthus retroflexus) and purslane (Portulaca oleracea) was 71, 72, 79, 75, and 53 per cent for the 1 pound rate of the sodium, amine and ester formulations of 2,4-D and the amine formulations of MCP and 2,4,5-T respectively. At the 2 pound rate, the reductions in the above order were 78,84,89,79, and 47 per cent. There were no significant differences in weed numbers at the time the second counts were made (8 weeks after planting) indicating that the effect of the treatments had been dissipated. The 2 pound application of MCP reduced the stand of onions by 24 per cent but did not reduce the yield. No other treatment had any significant effect on the stand or yield of onions. (Dept. of Horticulture, University of Wisconsin, Madison, Wis.)

36 Effect of several pre-emergence treatments on weed control and the growth and yield of lima beans. Warren, G. F. A replicated experiment was conducted on Henderson Bush lima beans planted 2 inches deep in a silt loam soil on June 16. On June 17, the sodium salt of 2,4-D at 1 and 2 pounds of acid equivalent per acre, Dow Selective at 6 gal. (13.7% ammonium dinitro-sec-butyl phenate), sodium PCP at 25 pounds, ammonium salt of TCA at 5 and 10 pounds of acid equivalent and a combination of TCA at 10 pounds and 2,4-D at 1 pound, were applied as aqueous sprays to the soil surface. Precipitation as light showers totaled 1.05 inches during the next two weeks but there were no heavy rains until July 20. Weed counts were made and the weeds removed from all plots 4 weeks after planting. Sodium PCP and 2,4-D gave 80 to 100 percent reductions in the stands of pigweed (Amaranthus retroflexus), purslane (Portulaca oleracea) and witchgrass (Panicum capillari) but only 30 to 65 per cent for foxtail (Setaria spp.), the 2 pound rate of 2,4-D giving the greatest reduction in stand of the latter weed. Dow Selective gave good control of purslane but only 30 to 50 per cent control of the other three weeds. TCA had little or no effect on purslane and pigweed but gave 82 to 96 percent control of the grasses. The combination of TCA and 2,4-D gave practically perfect control of all weeds present. One and 2 pounds of 2,4-D significantly reduced the stand of lima beans by 8 to 14 per cent respectively. The other treatments did not effect the stand. The yield was not reduced by 2,4-D, Dow Selective or sodium pentachlorophenate but

all plots that received TCA failed to produce any beans. Plants on the latter plots were stunted and distorted throughout the season. (Dept. of Horticulture, Univ. of Wisconsin, Madison, Wis.)

PROJECT VIII INVESTIGATION OF PHYSIOLOGICAL AND CHEMICAL FACTORS IN WEED CONTROL

Investigation leader: George L. McNew

As more data become available, it is obvious that there are many compounds in the 2,4-D (2,4-dichlorophenoxyacetic acid) group that may be used as herbicides. These compounds depend upon growth regulant ability as the concentrations used. The evidence shows that the basic structure must contain a chlorine in the 4 position of the phenoxy structure, an oxygen linkage between the phenyl and acetic acid groups, and a carboxyl group on the alkyl chain. The carboxyl group can be modified without destroying the basic activity provided a free C=O group remains. Thus the free acid, its amide, various metallic and amine salts and the esters are active.

The physical properties of 2,4-D can, therefore, be tailored to almost any specification. Increasing solubility and speed of action can be attained by progressing from the calcium and ferric salts through the sodium, potassium, ammonium, triethylamine, triethanolamine, piperidine, morpholine and other amine salts. The moderate volatility of the free acid can be reduced by converting it into a salt or it can be increased by conversion into an ester. This volatility of the esters can be controlled at will merely by varying the length of the carbon chain since the long-chain esters are less volatile.

There are good reasons why a non-volatile, highly-soluble compound should be sought. By controlling volatility one may apply the chemical with assurance that it will stay where it is sprayed. Non-volatile compositions will be safer to use on lawns, roadsides and large fields near susceptible crops and ornamentals. The esters have been more effective in the dry, warm areas of the Midwest, particularly on woody types of plants. Presumably this may be due to high volatility wherein they act in the gaseous phase to reach and penetrate the stomata. Obviously one would expect a narrower margin of safety from the volatile compounds when they are used as selective sprays. The highly soluble forms such as the amine salts are easy to formulate and may be readily washed from spray equipment. These conveniences plus their non-volatility has encouraged their use. The metallic salts are non-volatile but less soluble than the various amine salts (1 to 7 gm. vs. 200 to 700 gm. per 100 ml. at 20 to 30°C.)

The physical properties of the 2,4-D compounds also can be changed so as to secure better penetration by the addition of adjuvants such as detergents. Apparently the effects of sodium and amine salts of 2,4-D may be drastically changed by addition of sodium lauryl sulfate (Dreft). These normally safe materials can be rendered very injurious by reducing the surface tension from 70 to 35 dynes/sq. cm. There is some evidence of synergism between the two compounds that may contribute to the increased toxicity.

More evidence is accumulating to support the data of Rossman and Staniforth that inbred lines of corn differ sharply in their reaction to 2,4-D compounds. Two of the 28 lines tested at Illinois were resistant. This selective injury apparently affects the young seedling and roots of older plants. The tests made at Ohio on 4 inbred lines indicate that meiosis is not interfered with since the nuclei of microsporocytes were normal in the metaphase and anaphase. Further data are needed before arriving at a final conclusion. There are no data available to indicate whether the differences

in corn are due to variation in penetration of the chemical or to innate reaction of the line.

Even less is known about the disposition of the chemical after penetration into the host. Mitchell and Lindner found that 2,4-D invaded immature tissues most readily but did not move out of leaves that were low in carbohydrates. They found the yield of Pilot wheat was reduced but the protein content was enhanced. The data on corn from South Dakota show that there was a marked increase in the alpha amino acids in both roots and tops even though total nitrogen in the tops decreased and water soluble nitrogen increased. There is some evidence that esters may increase the sucrose content of potato tubers in Kansas. These observations indicate that the carbon-nitrogen balance in the plant is completely altered after the chemical gains entrance but it is too early to make any sweeping generalizations.

Soil conditions may be expected to affect the persistence of 2,4-D applied as pre-emergence treatments. In addition to volatilization, apparently the chemical is lost by leaching, hydrolysis or other decomposition. The decomposition is retarded in peat soils by drying, autoclaving or lowering the temperature. The chemical may leach from mineral soils, the extent of loss being closely correlated with the amount of organic matter present.

Soil conditions also influence the effectiveness of trichloroacetic acid and its salts since their principal avenue of penetration is by the roots. Highly calcareous soils precipitate the chemical as the insoluble calcium salt and excess of nitrates apparently interferes with the uptake of the chemical.

PROJECT VIII INVESTIGATION OF PHYSIOLOGICAL AND CHEMICAL FACTORS IN WEED CONTROL

Abstracts of Results of Individual Cooperators

1 Field studies on the physiology of TCA as an herbicide for the control of quack grass and blue grass. Barrons, Keith C. Plots receiving equal sprays with one immediately washed with water resulted in equal grass effect after three weeks even though severe top "burn" occurred on the unwashed plot while none occurred where trichloroacetic acid was washed from the foliage. Independence of the frequently observed contact action and the systemic effect resulting in retardation or killing of the grass is thus indicated and root absorption is shown to be the important avenue of entry. Equal effects from spraying closely mowed and unmowed grass and the roots of upturned sod indicate further the importance of root absorption. TCA acid and the sodium and ammonium salts appear equally effective. They are compatible with phenoxyacetic acids and phenolic contact herbicides. The latter observation further indicates the lack of significant foliage absorption. 10 lb/A of sodium TCA has given significant grass retardation over a considerable period while 40 lb/A appears to be an approximate minimum dose for significant kill. Soil moisture appears to be a critical factor. Inferior results on high nitrate soils indicate a possible internal or external nitrogen relationship. Inferior results on calcareous soils indicate possible fixation as the less soluble calcium or magnesium salts. (Contribution of the Dow Chemical Co., South Haven, Mich.)

2. Effects of 2,4-D when applied as a pre-emergent treatment on the sugar content of potatoes. Hamilton, Roger D., H. L. Mitchell and J. W. Zahnley. Pre-emergent treatments of Cobbler potatoes were made with 1/2, 1, 2, and 4 lbs. on acid basis of an iso-propyl ester and a monohydrate sodium salt per acre. Applications were made 14 days after planting on one series of plots and at 21 days after on the other. Due to the fact that the ground was dry and no rain fell within 3 weeks after planting, no differences could be observed between different dates of treatment. Treatments of 2 and 4 lbs. of ester and 4 lbs. of salt produced curling of the lower leaves, otherwise, no effects could be observed. Sugar analysis of the tubers from the plots treated with the ester showed an increase in the quantity of sucrose, while the salt treated plots varied from a decrease of sucrose to about the same as that of check. (Contribution of the Kansas Agricultural Experiment Station.)

3 Factors affecting the rate of inactivation of 2,4-D in peat soil. Hernandez, T. P. Experiments were conducted in the greenhouse to determine the effects of temperature, soil sterilization and moisture levels on the rate of inactivation of 2,4-D in peat soil. A sodium salt containing 70% of 2,4-D acid was used at the rate of 4 pounds per acre. The indicator plant used to determine the residual toxicity of 2,4-D in the soil was cabbage (Var. Wisconsin Hollander) grown from seed in the soil tested. The 2,4-D was added to the surface soil as an aqueous solution. Results on the effects of temperature on the rate of inactivation of 2,4-D showed that at 75° F. the 2,4-D in moist peat soil was inactivated at the end of 4 weeks of storage. At 40° F. the 2,4-D was still toxic at the end of 8 weeks of storage but was inactivated at the end of 12 weeks. When moist peat was sterilized, 2,4-D was found to be completely toxic at the end of 12 weeks, whereas, in unsterile soil it was inactivated at the end of 2 weeks. Sterilizing the soil, as shown by the control, did reduce the germination and growth of the cabbage

plants some. In a warm greenhouse 2,4-D was found to be toxic in air dry peat soil at the end of 16 weeks of storage; however, in both moist and water saturated peat soil, the 2,4-D was inactivated at the end of 2 weeks. (Contribution of Department of Horticulture, University of Wisconsin, Madison, Wis.)

4 Effect of organic matter contents on the rate that 2,4-D is leached in different soils. Hernandez, T. P. Mineral soils with different amounts of organic matter and a peat soil were used in greenhouse experiments to determine the rate that 2,4-D is leached with varying quantities of water. A sodium salt containing 70% of 2,4-D acid was used at the rate of 2 and 4 pounds per acre. The indicator plant used to determine the residual toxicity of 2,4-D was cabbage (Var. Wisconsin Hollander) grown from seed in the several layers of soil tested. The 2,4-D was added to the soil surface as an aqueous solution. The results showed that in mineral soils low in organic matter, the 2,4-D was much more readily leached than in mineral soil high in organic matter or in peat soil. In mineral soils with 0.25% and 2% organic matter, one surface inch of water was sufficient to move 2,4-D in highly toxic concentration to a depth of at least 5 inches into the soil when 2 pounds or more of 2,4-D per acre was applied to the soil surface. In mineral soil with 9% organic matter or in the peat soil, using 4 pounds of 2,4-D per acre, 4 surface inches of water only moved the 2,4-D in slightly toxic concentration to a depth of 3 inches. (Contribution of Department of Horticulture, University of Wisconsin, Madison, Wis.)

5 Some effects of 2,4-D dichlorophenoxyacetic acid on the nitrogen and carbohydrate metabolism of the corn plant (Zea mays L.) Clifford H. Hullinger. In a preliminary study of the effects of 2,4-Dichlorophenoxyacetic acid upon the nitrogenous and carbohydrate constituents of the corn plant (Zea mays L.), 2,4-D concentrations of 0, 5, 10 and 20 p.p.m. were supplied in a water culture solution. All concentrations (except control) were toxic to the corn plant, probably due to the extreme warm temperature encountered in the greenhouses during the study.

The following observations were made in comparing the treated with the untreated series: 2,4-D reduced turgor and lowered moisture content as well as dry plant weight; reducing sugars increased in the green tops, but decreased in the roots; sucrose increased in both tops and roots, the increase in the latter tissue being slight; total nitrogen decreased in the tops and showed a minor increase in the roots, though water-soluble nitrogen compounds increased in the tops and decreased in the roots; a small decrease was found in the "true protein" nitrogen of the tops; ammonium nitrogen increased slightly in the tops and to a greater extent in the roots; glutamine and asparagine increased in both tops and roots, but the marked change was in residual a-amino acids (this value excludes the a-amino nitrogen of the amides, glutamine and asparagine) which increased rapidly in both tops and roots; minor increases in the basic nitrogen constituents of both top and root tissues were detected. (Contribution of the Department of Experiment Station Chemistry, South Dakota State College.)

6 Effect of 2,4-D treatment on meiosis in four inbred lines of corn. Kramer, N. W., and E. F. Paddock. Microsporocytes were collected in 1948 from four inbred lines of corn that had been treated with 1-1/4 pounds acid equivalent per acre of the butyl ester of 2,4-D when the corn was 24-30 inches tall. Preliminary examinations of metaphase I, anaphase I, metaphase II and anaphase II figures have shown no meiotic irregularities. (Contribution from the Ohio State University.)

7 Differential seedling response of corn inbred lines to 2,4-D treatment. Leng, E. R. and F. W. Slife. Seedling response of twenty-eight inbred lines of corn to treatment with 2,4-D was studied under greenhouse conditions. Treatments used were pre-emergence spray and soaking of seed in solutions of the chemical before planting.

Wide differences were observed between inbred lines in their reaction to treatment. In all tests, inbreds WF9 (dent) and 6-355 (sweet) were outstanding in resistance to injury caused by 2,4-D. Inbreds K4, Kys, K64, and O7 were particularly severely injured. Sensitivity to 2,4-D was demonstrated in reduced germination, stunting of top growth, and marked inhibition and abnormality of root development.

Further greenhouse and field tests are being conducted to study reactions of these inbred lines and crosses involving them in greater detail. (Contribution of Illinois Agr. Expt. Station.)

8 The growth regulant, herbicidal and physical properties of chemicals related to 2,4-D. McNew, George L. and Otto L. Hoffman. Fifty-three compounds related to 2,4-dichlorophenoxyacetic acid (2,4-D) were tested by precision spraying of potted beans and tomatoes to determine the relation of chemical structure to herbicidal and growth regulant abilities. The phenoxy nucleus is superior to the naphthoxy. Halogenation is essential for maximum activity of phenoxyacetic acid (PA) since 4-Cl-PA and 2,4-dichloro-PA are equivalent and approximately ten times as active as 2-Cl-PA. Comparable activity cannot be attained by using anilino, $NH_3 \cdot HCl$, NO_2 or $NCOCH_3$ groups in the 4 position. 2,4-Dibromo-PA is equivalent to 2,4-D in regulant ability but inferior as a herbicide. 2,4,6-trichloro-PA is relatively inactive but 2,4,5-trichloro-PA is more caustic and less regulant than 2,4-D.

The carboxy group of 2,4-D is essential for activity since phenylalkyl ethers are inactive except for caustic action of members with unsaturated carbon chains. The carboxy group can be modified to produce the amide, salts or esters without destroying activity provided a C=O group remains free. Substitution of a large group such as anilino or cyclohexylamine reduces activity. The ferric and calcium salts are less active than sodium, potassium, ammonium, alkylamine or alkanolamine salts.

The volatility and solubility of these compounds differed. A highly soluble, non-volatile herbicide was sought because of ease and safety in application. The triethanolamine and related salts of 2,4-D were selected as possessing the most satisfactory chemical, physical, and herbicidal properties. (Contribution from Botany Dept., Iowa State College and Naugatuck Chemical Division of U. S. Rubber Co.)

9 Physiological research on weed control at the U. S. Plant Industry Station. Mitchell, John W. and Paul J. Linder. In applying 2,4-D to various parts of test plants, greatest toxic effect was obtained when relative immature portions of the stems were treated. 2,4-D was not translocated from the leaves of test plants that were low in readily available forms of carbohydrates. This relationship between translocation of carbohydrates and 2,4-D was observed when widely different amounts of the chemical were used, when six different forms of 2,4-D were used, and when three different carriers of 2,4-D were used.

2,4-Dichlorophenoxyacetic acid, 2,4-dichlorophenoxyacetamide and 4-

chlorophenoxyacetic acid reduced the yield of Pilot wheat when applied as sprays at concentrations of 0.1% at the time of pollination. These compounds caused a slight but not significant reduction in the yield of Federation wheat treated in a similar manner. All compounds caused a significant increase in the protein content of the seeds of Pilot but only 2,4-D acid and the amide affected Federation in this way. In general, increased protein content of the grain was associated with a corresponding decrease in the weight of seeds produced. (Contribution of the Division Fruit and Veg. Crops and Diseases, U.S.D.A.)

10 The volatility of several salts and esters of 2,4-dichlorophenoxy acetic acid as determined by the response of tomato, bean, and cotton plants. Mullison, Wendell R. Potted plants were placed under bell jars along with various 2,4-D derivatives in small dishes. The plants were held confined in such an atmosphere for periods from 1/4 hour to 65 hours. An alkanolamine salt and the sodium salt of 2,4-dichlorophenoxy acetic acid were non-volatile as determined by the responses of tomato, bean, and cotton plants. Aliphatic (1-5 carbon) esters of 2,4-dichlorophenoxy acetic acid and the isopropyl ester of 2,4,5-trichlorophenoxy acetic acid were sufficiently volatile to cause decided plant responses. The short exposure periods of 15 minutes at 100°F. or 30 minutes at room temperature (73-80°F.) to the vapors of the methyl ester of 2,4-dichlorophenoxy acetic acid were sufficient to cause plant responses. These experiments indicate that as the number of carbon atoms in the aliphatic portion of the 2,4-D ester is increased the volatility decreases. The results of these experiments strongly indicate that unsprayed plants adjacent to or in the vicinity of plants treated for weed control will not be affected due to volatilization of 2,4-dichlorophenoxy acetic acid, its sodium, or alkanolamine salt. (Biochemical Research Laboratory, The Dow Chemical Company, Midland, Michigan.)

11 Surface tension and synergism in 2,4-D sprays. Staniforth, D. W. and W. E. Loomis. Various wetting agents have been recommended for use in 2,4-D sprays. Some early experiments with Dreft, a commercial formulation of sodium lauryl sufate, indicated a considerable increase in toxicity. During the past season Dreft at 0.5 per cent has been combined with sodium and amine salts of 2,4-D, on replicated plots of corn, flax and soybeans. This quantity of Dreft reduces the surface tension of the sodium salt sprays from around 70 to about 30-35 dynes per cm. The surface tension of ester sprays was unchanged at 30+ dynes. The yield of flax was reduced 0-25 per cent by dosages of 1/8, 1/4 and 1/2 lb./acre of 2,4-D acid as the ester, sodium salt and amine salt. Addition of Dreft to the sodium and amine salts reduced flax yields up to 65%; the effect on the ester was very much less. Dreft solutions alone gave no yield reductions. In corn spraying tests, the addition of Dreft increased the toxicity of all the 2,4-D formulations as evidenced by growth response and yield. Dreft solutions alone gave a slight yield reduction. Increases up to 2%, in the Dreft added to the 2,4-D solutions gave increased toxicity. Different wetting agents, added to 2,4-D solutions at approximately equal surface tensions, gave differences in toxicity. Tests on potted soybean plants in the greenhouse, showed that the addition of Dreft to the sodium and amine salts of 2,4-D, greatly increased inhibition of new growth, but ester + dreft was only slightly more inhibiting than ester alone. Not all of the effects of Dreft appear attributable to surface tension changes, and there is evidence that sodium lauryl sulfate may have a synergistic action in spray solutions of the sodium and amine salts of 2,4-D. (Contribution of the Iowa Agric. Expt. Station, Botany and Plant Path. Sec.)

12 Effect of several herbicides on germination of sugar-beet seed. Swanson, Charles R. As a preliminary means of evaluating certain herbicides for the pre-emergence weeding of sugar-beets, a sodium salt of 2,4-dichlorophenoxyacetic acid (2,4-D), a dinitro compound (Sinox W), and ammonium trichloroacetate (TCA) were tested as to their effect on the root length and rate of germination of sugar beet seed. Seeds were treated with concentrations of each chemical to a maximum of 4000 ppm. Germination counts were made periodically for four days and root lengths were determined at the end of this period. Concentrations of 25 ppm. of 2,4-D caused marked reduction in root elongation whereas concentrations as high as 4000 ppm. caused only slightly greater inhibition. Similar inhibition was observed in seeds treated with a dinitro compound but the reduction was more gradual with increasing concentrations. TCA stimulated root elongation at low concentrations. 2,4-D decreased the rate of germination in proportion to the concentration of the chemical. The effect of dinitro was similar to but more severe than 2,4-D concentrations of 2000 and 4000 ppm. of dinitro inhibited germination almost completely. TCA had little effect on the rate of germination except at the 4000 ppm. level where there was noticeable retardation. From these experiments it would appear that 2,4-D and the dinitro used are of questionable value for pre-emergence weed control in sugar-beets. TCA would seem to be satisfactory at least as far as its effect on the sugar-beet seed is concerned. (Contribution of Div. of Cereal Crops & Diseases, BPISAE, U. S. Dept. of Agriculture, and N. Dak. Agricultural Expt. Station.)

13 Some factors influencing the penetration and mobility of chemicals in mesquite. Fisher, C. E. and Dale W. Young. Mesquite (Prosopis juliflora) is a woody sprouting shrub that occurs on approximately 75 million acres of native grassland in the southwest. Investigations begun in 1938 to determine effective and economical methods of control are divided into (1) chemical (2) mechanical and (3) biological phases. This paper deals with factors that influence absorption and mobility of certain chemicals when applied to foliage, cut surfaces, and roots of mesquite. The length of moist contact on leaf surface, formulations of chemical used in oil, water or oil emulsion, rate of growth and atmospheric conditions are the most important factors found to influence absorption and mobility of chemicals in mesquite. Results are based on field trials and injection studies with sodium arsenite, ammonium sulfamate, sodium chlorate, 2,4-D, 2,4,5-T and sodium trichloroacetate. A special technique to test rapidly the absorption and mobility of untried chemicals when applied to the foliage of mesquite is also reported. (Contribution from the Texas Agr. Expt. Station, Substation No. 7, Spur, Texas.)

14 A quantitative bio-assay for 2,4-dichlorophenoxyacetic acid and other water soluble herbicides. Brown, Clair A., Q. L. Holdeman and E. S. Hagood. When 2,4-D was first used for weed control there was no simple method of evaluating the actual or relative toxicity of the different formulations or of other herbicides. Field tests have resulted in conflicting results as might be expected. A bio-assay, using germinating rice seed, which may be useful to other workers has been in use for three years. Other workers have published results on the use of radish, corn and cucumber seeds. Some of the advantages in the use of rice are its great sensitivity to low concentrations of 2,4-D and the clear cut inhibition of the development of the primary root. Rice seeds were germinated in petri dishes on filter paper moistened with 5 cc. of the formulation being tested. The outstanding response was the nearly complete inhibition of the primary root of Zenith rice at 1 ppm. solution of 2,4-D acid at 72°F. for 5 days. Several rice varieties gave the same response. A

comparison of 2,4-D acid, the sodium salt, the triethanolamine, and the butyl ester showed no significant difference when compared on the acid equivalent basis. The inhibition reaction on rice seeds was used to demonstrate translocation and recovery of a toxic principle from a plant where a 2,4-D formulation was watered into the soil. The extract of this plant when applied to cotton produced typical 2,4-D symptoms. The same degree of root inhibition exhibited by the use of 2,4-D acid at the 1 ppm. level was obtained when rice was tested with isopropyl phenyl carbamate at 25 ppm., Sinox W at 50 ppm., Sinox General at 50 ppm., sodium cyanamide at 1,000 ppm., potassium cyanate at close to 2,500 ppm., sodium isopropyl xanthate between 2,500 and 5,000 ppm. and ammonium trichloroacetate above 5,000 ppm. (Louisiana State University and Agricultural Experiment Station.)

15 A study of volatility effect of 2,4-D. Anderson, E. T. and A. B. Mantell. A series of experiments to test the effect of volatility and drift of 2,4-D on sensitive indicator plants were conducted under different weather conditions during the summer of 1948. Tomato and bean plants grown in pots were used as indicators. Sodium salt and Butyl ester of 2,4-D were sprayed on lawn areas at the rates of 1 lb. and 1/2 lb. respectively of 2,4-D acid equivalent per acre. Indicator plants were placed at definite distances, ranging from 1 to 20 feet from the treated areas. One group of plants was in place at the time of spraying and allowed to remain for several days, a second group was treated similarly, but removed immediately after spraying, a third group was placed after spraying and allowed to remain. The experiments were repeated several times under different sets of temperature and humidity.

The results were not clear cut and on the basis of one summer's work definite conclusions cannot be made. Certain observations are of interest. 1. Distortion of plant growth, though most noticeable on those plants in place at the time of spraying, was also apparent in many of the plants placed after spraying; suggesting a volatile effect. 2. The volatile effect, that is the effect on group three of the series was in general more pronounced as a result of the ester treatments. 3. Those where treatments were carried out in the morning (from 8 to 9 o'clock A.M.) showed greater injury than similar treatments made during the afternoon and evening. In general, temperature was lower and relative humidity higher in the morning than during the afternoon and evening. 4. Plants placed in the treated areas following a time lapse of as much as 29 days after spraying and covered with bell jars for short periods developed noticeable distortion. This residual effect was not appreciably different with the two formulations. (Project sponsored by the Botany Division, Dominion Dept. of Agriculture, Ottawa.)

16 The effect of 2,4-D on the chemical composition of green plants. Heggeness, H. G. Seven flax varieties were treated in the pre-bud stage (4"-6") with various 2,4-D formulations, including an amine (triethanolamine), the sodium salt, and the butyl ester. The 2,4-D acid was applied at the rate of 4 oz., 8 oz., and 16 oz. per acre. The seeds and stem material were analyzed, as follows. 1. Varietal differences were apparent and there was a general tendency for increased 2,4-D applications to reduce the oil content, the ester formulation having the greatest effect. 2. Varietal differences in iodine value of the oil were very apparent. In general, as the amount of herbicide increased, the iodine value decreased. The ester formulation had the greatest effect, with a maximum reduction in iodine value of about 15 points. 3. Several flax varieties were carefully studied and from these results it was apparent that the treatments had not influenced the crude fiber content. 4. From the figures for total ash it is apparent that the 2,4-D applications have had a significant effect on the over-all ash content. There is evidently a trend to heavier ash per unit weight in the controls. 5. This data indicates that there may be significant variations in phosphorus from controls in the treated samples. 6. More data will have to be collected before definite conclusions can be drawn regarding potassium in stems. 7. Re-

sults so far secured indicate that the application of 2,4-D has influenced the absorption of calcium by the flax plant. Calcium content was reduced upwards of 80% in certain stems. The composition of the growing medium influences the effect of 2,4-D on plants. (Contribution of Division of Plant Pathology & Agricultural Botany, University Farm, St. Paul, Minnesota.)

17 The effect of herbicidal oils on the photosynthesis of umbelliferous crop plants and certain weeds. Minshall, Wm. Harold and V. A. Helson. The effect of a petroleum naphtha (boiling range 300-400°F.) on the photosynthesis of attached leaves of parsnip, carrot, common mustard, lamb's quarters, and common chickweed has been studied at Ottawa. By means of an infrared absorption apparatus, readings were taken at ten-second intervals following the spraying of the leaves with the oil. For all the plants studied, photosynthesis ceased abruptly and completely immediately following the application of the oil. By the same apparatus, the recovery of photosynthesis in parsnip and common mustard leaves following their immersion for four seconds into the petroleum naphtha has been followed. With parsnip, true photosynthesis started to recover within 30 minutes after the immersion, and was almost one-third of the original rate at the end of three hours. The photosynthetic rate of parsnip continued to increase until, at the end of 48 hours, it was approaching normal. With mustard, there were indications of a slight temporary recovery of true photosynthesis starting within 30 minutes after the immersion and continuing for approximately one hour. Following this temporary recovery, however, true photosynthesis completely ceased. Apparently the disruption of photosynthesis, following the application of the oil, is temporary in parsnip but permanent in mustard. (Contribution of Div. of Bot. & Plant Path., Science Service, Dom. Dept. Agric., Ottawa, Canada.)

18 The effect of herbicidal oils on the transpiration of umbelliferous crop plants and certain weeds. Minshall, Wm. Harold, and V. A. Helson. By means of an infrared absorption method, the time course of transpiration has been determined for attached leaves of parsnip and mustard following the application to them of drops of a petroleum naphtha (boiling range 300-400°F.). With parsnip leaves, a decrease of from 25 to 40% occurred in the transpiration rate within 10 minutes after the application of the oil. Transpiration then continued to decrease at a steady but slower rate until, at approximately 90 minutes after the oil was applied, it levelled off at 20% of maximum transpiration (about double the rate of cuticular transpiration for this species.) Transpiration then remained at the 20% level until, at approximately 3 hours after the oil was applied, it started to recover and, 5 hours after the application, it had increased to one-half the original rate. It then continued to increase but at a very low rate. With mustard leaves the immediate effect of the oil on transpiration was similar to that for parsnip in that a rapid initial drop of approximately the same extent occurred within 10 minutes, followed by a steady but slower rate of decrease. Transpiration of mustard leaves, however, continued to decrease until cuticular transpiration was reached at approximately 90 minutes after the oil was applied. Thereafter no indication of any recovery occurred. The length of time required for the transpiration rate of an oil-treated attached mustard leaf to be reduced to the cuticular level was approximately the same as that for an untreated detached leaf. These results indicate that, when oil is applied to the leaves, transpiration ceases permanently in mustard but in parsnip it recovers after a temporary reduction. (Contribution of Div. Bot. & Pl. Path., Science Service, Dom. Dept. Agric., Ottawa, Canada.)

APPENDIX
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C. J. Willard

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS

Tabular Data of Results of Individual Cooperators.

Perennial Sow Thistle

Ab. 1 Use of 2,4-D in control of perennial sow thistle (Sonchus arvensis L.) Bohmont, Dale W. (Contribution of the University of Wyoming, College of Agriculture & Experiment Station.)

Concentration	Material % Survival Counts Ester	Amine	Salt	Check
¼ pound	53.1	75.4	75.5	
¾ pounds	20.4	25.5	31.9	
1¼ pounds	29.4	16.8	52.3	
2 pounds	30.8	2.3	21.6	
No Treatment				78.4
August all Concentrations	33.4	30.0	37.8	

Variation Due To	D.F.	Sx^2	$\bar{x}$	F
Treatment	12	74,913.32	1242.78	* 2.6
Blocks	1	782.11	782.11	
Error	12	5,683.91	473.66	21.73
Total	25	81,379.34		

* Standard Error of the Mean Difference - 21.73

Treatment	Percent Survival (Sow Thistle) Rep. I	Rep. II	Summary	% Survival
Ester ¼	32.8	73.5	106.3	53.1
Amine ¾	16.9	34.1	51.0	25.5
Na Salt 1¼	19.5	85.0	104.5	52.3
Ester 1½	25.6	33.3	58.9	29.4
Amine 1¼	19.7	13.9	33.6	16.8
Na Salt ¾	34.1	29.8	63.9	31.9
Amine 2#	00.3	4.4	4.7	* 2.3
Ester ¾	26.8	14.0	40.8	20.4
Amine ¼	56.5	94.3	150.8	75.4
Na Salt 2#	33.7	9.5	43.2	21.6
Check	100.0	56.9	156.9	78.4
Ester 2#	25.5	36.2	61.7	30.8
Na Salt ¼#	50.9	100.0	150.9	75.5
	442.3	584.9	1027.2	

Ab. 2 The effect of treating and retreating perennial sow thistle with three formulations of 2,4-D at three rates of application. Derscheid, Lyle A.; L.M. Stahler and D.E. Kratochvil. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and Bureau of Plant Industry, Soils and Agricultural Engineering. U.S.D.A.).

Treatment	Lbs. of 2,4-D acid per acre	After one treatment on July 9, 1947 counted Sept. 8,1947		After two treatments July 9, & Sept. 8,1947 counted June 25, 1948	
		Live plants per sq.yd.	per cent killed	Live plants per sq.yd	per cent killed
Ester	¼	15.5	65.0	6.0	84.0
Amine	¼	37.7	14.9	8.0	78.7
Sodium	¼	38.0	14.4	12.0	68.0
Ester	¾	0.2	93.5	0.7	98.1
Amine	¾	27.7	37.5	3.2	91.5
Sodium	¾	22.3	49.7	1.3	96.7
Ester	1 ¼	0.2	93.5	2.0	94.7
Amine	1 ¼	15.0	66.2	2.5	93.4
Sodium	1 ¼	14.0	70.0	2.0	94.7
Untreated	---	44.3	00.0	37.5	00.0

Ab. 6 Effect of foliage sprays with ester and amine formulations of 2,4-D acid on intact and severed perennial sow thistle plants (Sonchus arvensis). Corns, W.G. (Contributed by the Department of Plant Science, University of Alberta, Edmonton, Alberta, Canada.)

Formulation:	Amine		Ester	
Plants:	Cut	Intact	Cut	Intact
Treatments in lb. 2,4-D as acid per acre, applied July 20 & 27 resp.	** Aerial growth all ester-treated plants dead 4 to 6 weeks; parts amine-treated plants green 7 to 9 weeks after treatment.			
0 + 1½				
* Root weight 2 mos. after treatment	450	782	20	69
Root "Crowns": dead	4	2	11	12
(even trace viable) living	11	13	4	3
1½ + 0				
Root weight	526	615	8	49
"Crowns": dead	2	3	15	15
living	13	12	0	0
½ + 1				
Root weight	262	604	20	66
"Crowns": dead	4	0	13	13
living	11	15	2	2
½ + ½				
Root weight	522	1016	5	60
"Crowns": dead	1	0	14	12
living	14	15	1	3
** Regrowth throughout	- abundant - 15-25 plants sq. yd.		- rare -	

* Fresh wt. in gm. of apparently viable roots from 5 plants each removed from cylinder of soil 1 yd. in diam. by 9" deep.

Ab.12 Control of leafy spurge with 2,4-D and 2,4,5-T. Slife, F. W., R. F. Fuelleman, and W. O. Scott. Leafy spurge (Euphorbia esula) was treated with ½, 2, and 4 pounds of acid in the ester and amine forms of 2,4-D, and with similar rates of the ester form of 2,4,5-T. Replicated square rod plots were located in two different areas. In one area no attempt had been made to control the spurge in previous years; in the other area good cultural practices had been followed which reduced the vigor of the spurge. In each area a replicated series of plots were sprayed only on May 12; on a similar series, plots were sprayed only on May 12 and July 10.

AREA WITH NO PREVIOUS CONTROL, SPRAYED MAY 12 AND July 10

Formulation	Rate lbs.acid per acre	Regrowth in percent of May 12 population. All plots treated May 12 and July 10, 1948.		
		May 12	July 10	September 17
Ester	1/2	100	94.0	75.0
	2	100	85.1	76.0
	4	100	58.7	42.5
Amine	1/2	100	88.7	76.2
	2	100	82.4	67.1
	4	100	84.7	56.0
2,4,5-T	1/2	100	87.7	79.2
	2	100	85.3	70.7
	4	100	80.7	53.8
Check	0	100	97.9	96.5

AREA WITH GOOD CULTURAL PRACTICES SPRAYED MAY 12 AND JULY 10

Ester	1/2	100	82.3	35.2
	2	100	50.0	16.6
	4	100	58.3	16.6
Amine	1/2	100	85.7	50.0
	2	100	70.0	40.0
	4	100	51.7	13.7
2,4,5-T	1/2	100	85.7	88.8
	2	100	80.0	42.8
	4	100	60.0	40.0
Check	0	100	101.2	97.0

One spraying on May 12 was ineffective in materially reducing the stand in either area. The figures show that two sprayings have reduced the stand, but examination of the root systems on all plots show little injury below a depth of six inches.

Fall applications were made in September on new plots. Examination of these plots in October showed the leaves and stems to be dead, but the root system was alive at the ground level and new buds were appearing. This would indicate that 2,4-D has not been translocated to as great a depth in fall applications as it was in spring sprayings. (Contribution of Ill. Agr. Exp. Sta., Urbana, Ill.)

Summary table for per cent control of Sow thistle
Treated at 3 stages and with 3 rates of 3 2,4-D Formulations

Rate	Stages	Formulations (Average 3 Reps.)			Rate Average
		Sodium Salt	Amine	Ester	
0	2" - 4" in height	0	0	0	0
3/4	"	60.0	65.0	76.7	67.2
1	"	60.0	70.0	86.7	72.2
1-1/2	"	65.0	86.7	93.3	81.7
Average		61.7	73.9	85.6	
0	6" - 8" in height	0	0	0	0
3/4	"	55.0	80.0	81.7	72.2
1	"	71.7	79.3	91.7	80.9
1-1/2	"	75.0	82.3	95.0	84.1
Average		67.2	80.5	89.5	
0	Early bud	0	0	0	0
3/4	"	58.3	75.3	81.7	71.8
1	"	66.7	82.7	83.3	77.6
1-1/2	"	60.0	83.3	91.7	78.3
Average		61.7	80.4	85.6	
Formulation Average		63.5	78.3	86.9	
M.S.D. for formulations	x 15.94%				
M.S.D. for rates	x 4.91%				

(Contribution Leggett, H. W., Experimental Farms Field Husbandry Division, Lacombe, Alberta, Canada.)

14. A comparison of the effectiveness of different commercial preparations of 2,4-D in eradicating field bindweed. Woesteneyer, V. W. (Contribution of Kansas Agr. Exp. Sta.)

Preparation	Type	Bindweed plants per sq. rd. (1). Original	90 days after treat.			Per cent of original stand remaining 90 days after treatment		
		1946	1946	1947	1948	1946	1947	1948
2,4-Dow Weed Killer powder	Sodium Salt	495	66	40	2.5	13.3	8.1	0.5
DuPont IN-6-65-A-7	Ammonium Salt	483	49	43	6.5	10.3	8.9	1.3
Chipman's	Sodium Salt	488	58	37	2.0	11.9	7.9	0.4
Tufor	Amine	463	43	47	4.5*	9.4	10.2	1.0*
2,4-Dow Weed Killer liquid	Amine	470	65	78	7.5	13.9	17.0	1.6
Weedone	Ester	488	47	31	2.5	8.6	6.4	0.5
Weed-no-More	Ester	458	38	25	3.0*	8.3	5.5	0.7*
Weedanol M 1	Acid	475	36	46	1.0*	7.8	9.7	0.2*
Averages of three salt sprays		488	58	40	3.7	11.8	8.3	0.7
Averages of two amine sprays		467	54	63	6.0	11.7	16.6	1.3
Average of two ester sprays		473	43	28	2.8	8.5	6.0	0.6
One acid spray		475	36	46	1.0	7.8	9.7	0.2
Average of all sprays		478	50	43	3.7	10.4	9.2	0.8

1. Data are averages of duplicate plots. All products were applied at the rate of two pounds per acre of 2,4-D acid equivalent.

* All bindweed plants have apparently been eradicated on one of the duplicate plots.

15. Use of 2,4-D in controlling field bindweed. Woestemeyer, V. W. (Contribution of Kansas Agricultural Experiment Station)

Treatment	Rate(2)	Bindweed plants per sq. rd. (1) Late Bud Stage: Original 1948	Late Bud Stage: Remain 10-1-48	Late Bud Stage: Remain 10-15-48	Full Bloom Stage: Original 1948	Full Bloom Stage: Remain 10-1-48	Full Bloom Stage: Remain 10-1-48
Untreated	0	875	840	96	700	775	111
Sodium	1/2	1050	1065	101	665	750	113
"	3/4	575	505	88	550	720	131
"	1	665	275	41	625	1000	160
"	2	750	190	25	750	1015	135
"	3	740	305	41	1125	1150	102
Amine	1/2	750	540	72	350	725	207
"	3/4	925	440	48	350	540	154
"	1	750	565	75	550	875	159
"	2	900	565	63	525	775	148
"	3	800	665	83	590	565	96
Ester	1/2	1050	515	49	540	290	54
"	3/4	675	235	35	615	625	102
"	1	600	375	63	385	490	127
"	2	625	450	72	550	900	164
"	3	500	450	90	415	890	214

(1) Bindweed counts are averages of duplicate square rod plots.
(2) Applied in 40 gallons of water per acre.

16. Relation of stage of growth and rate of application to the effectiveness of 2,4-D in eradicating field bindweed. NCWCC Proj. K, 1948, Fort Hays Experiment Station, Hays, Kansas. Phillips W. M. (Contributed by the BPI, S&AE. USDA)

Type of 2,4-D	Rate: lbs. 2,4-D/acre	Percent bindweed regrowth from treatments made at different stages of growth (1): Complete emergence	First bloom	Full bloom
Ester	1/2	33.6	6.2	20.8
	1	19.0	3.1	11.9
	1 1/2	20.2	5.5	7.9
	2	4.1	12.4	5.4
	Average	19.2	6.8	11.5
Amine	1	22.1	8.5	2.4
	1 1/2	15.6	6.8	2.3
	2	11.7	2.9	3.0
	3	17.3	3.7	6.9
	Average	16.7	5.5	3.7

(1) All data are averages of three replications.

17. The relation of stage of growth and rate of application to the effectiveness of 2,4-D in eradicating field bindweed at the Fort Hays Experiment Station, Hays, Kansas. NCWCC Uniform Exp. No. I-2, 1946. Summary of the data for 1946, 1947, and 1948. Phillips, W. M. (Contributed by the Bureau of Plant Industry, Soils and Agricultural Engineering, Division of Cereal Crops and Diseases, U.S.D.A.)

Percent of bindweed regrowth of after original treatments in 1946 and retreatments in 1947 and 1948 (2)

Type of 2,4-D product used	Rate: lbs. of 2,4-D per acre (1)	Full Emergence			Bud to Early Bloom			Full Bloom			Fall Growth	
			1947	1948		1947	1948		1947	1948		1947
		Original	Retreatment	Retreatment	Original	Retreatment	Retreatment	Original	Retreatment	Retreatment	Original	Retreatment
Sodium salt	1	28	17	.6	33	5.0	.3	24	1.4	1.0	11	5.4
	2	15	13	.2	30	7.7	1.9	22	1.3	.8	8	.8
	3	23	13	.4	17	3.8	.7	8	.2	tr.	3	1.1
	4	19	17	.4	17	2.2	.3	11	.1	.4	8	1.6
	Average	21	15	.40	24	4.7	.80	16	.8	.55	8	2.23
Triethanolamine salt	1	20	13	.4	43	3.1	.2	28	.9	1.3	16	6.9
	2	21	9	.2	36	3.6	.3	30	1.6	1.4	14	7.6
	3	11	18	.3	25	3.9	1.2	24	1.6	1.6	21	6.7
	4	19	26	1.1	7	2.4	.3	19	2.9	1.6	7	6.5
	Average	18	17	.25	28	3.3	.50	25	1.8	1.48	15	6.93
Butyl ester	1				12	1.6	tr.				6	2.7
	2				11	1.8	.9				2	1.7
	3				13	1.5	.3				4	1.9
	4				12	3.6	.6				4	1.7
	Average				12	2.1	.45					2.0

(1) Retreatments in 1947 and 1948 were made approximately a year later than the original treatments in 1946 at the same stages of growth and rates of application.

(2) All data are averages of three replications.

18. The relation of stage of growth and rate of application of different types of 2,4-D formulations in eradicating field bindweed. NC WCC Uniform Exp. No. 1-2, 1947, at the Hays Experiment Station, Hays, Kansas. Phillips W. M. (Contributed by the Bureau of Plant Industry, Soils and Agricultural Engineering, Division of Cereal Crops and Diseases USDA.

Types of 2,4-D product used trade name in ()	Rate: lbs. of 2,4-D/acre (1)	Percent of bindweed regrowth from treatments made at different stages of growth (2)					
		Complete Emergence		First Bud		Full Bloom	
		Original	1948 Retreatment	Original	1948 Retreatment	Orig.	1948-Retreatment
Sodium salt (2,4-Dow Weed Killer, Powdered)	1	10.0	1.0	21.2	2.1	8.6	6.6
	2	9.3	2.0	4.9	1.1	7.1	13.7
	3	12.1	4.5	2.1	0.	6.1	12.3
	4	7.7	2.3	2.7	4.4	4.9	3.2
	Average	9.8	2.45	7.5	1.9	6.7	8.95
Triethanolamine salt (Tufor 40)	1	7.1	1.8	26.8	12.5	9.0	5.5
	2	7.3	1.8	25.1	10.7	8.0	.9
	3	8.0	.9	12.0	2.7	6.5	3.3
	4	11.5	0.	3.3	1.5	8.1	1.8
	Average						
Butyl ester (Weed-no-more	.5	18.2	0.	2.0	2.7	6.8	7.5
	1	12.4	3.8	1.0	1.8	6.6	1.2
	2	13.2	2.1	.3	0.	12.5	2.3
	3	6.7	1.3	2.0	13.1	18.4	4.6
	Average	12.6	1.8	1.3	4.4	11.1	3.9

(1) Retreatments were made in 1948 approximately one year later than the original treatments in 1947 at the same stages of growth and rates of application.

(2) All data are averages of two replications.

19. The Effect of four 2,4-D sprays and two 2,4-D dusts on Field Bindweed when applied at from different rates of three stages of growth at Scotland, South Dakota in 1947. Derscheid, Lyle A. and L. M. Stahler, (Contributed by Agronomy Department of South Dakota Agricultural Experiment Station and Bureau of Plant Industry, Soils and Agricultural Engineering, United States Department of Agriculture.)

Treatment	Pounds of 2,4-D acid per acre	Live Plant counts on June 1, 1948							
		Spring rosette Treated June 5,'47		Full Bloom Treated June 22,'47		Full rosette Treat. Sept.18,'47		Average	
		Plants per sq.yd.*	Per cent kill	Plants per sq.yd.*	Per cent kill	Plants per sq.yd.*	Per cent kill	Plants per sq.yd.	Per cent kill
Ester	5/8	2.5	92.2	0.8	97.5	1.2	96.2	1.5	95.3
Amine	5/8	1.3	96.0	1.3	96.0	2.3	93.8	1.6	95.0
Sodium	5/8	1.7	94.7	2.0	93.7	1.5	95.3	1.7	94.7
Ammonium	5/8	1.7	94.7	1.0	96.9	3.3	89.6	2.0	93.7
Ester dust	5/8	5.0	84.3	0.8	97.5	1.3	95.9	2.4	92.5
Sodium dust	5/8	2.9	90.9	2.0	93.7	3.7	88.4	2.9	90.9
Ester	1 1/4	2.3	93.8	0.2	99.4	2.2	93.7	1.6	95.0
Amine	1 1/4	1.0	96.9	0.5	98.4	2.3	93.8	1.3	95.9
Sodium	1 1/4	1.2	96.2	0.5	98.4	2.7	91.5	1.5	95.3
Ammonium	1 1/4	1.2	96.2	0.7	97.8	3.3	89.6	1.7	94.7
Ester dust	1 1/4	3.5	89.0	0.8	97.5	1.0	96.9	1.8	94.3
Sodium dust	1 1/4	4.5	85.8	3.5	89.0	1.8	94.3	3.3	89.6
Ester	1 7/8	2.3	93.8	0.3	99.1	1.0	96.9	1.2	96.2
Amine	1 7/8	1.3	96.0	1.3	96.0	2.8	91.2	1.8	94.3
Sodium	1 7/8	2.5	92.2	0.7	97.8	0	100.0	1.1	96.5
Ammonium	1 7/8	1.9	94.0	1.2	96.2	4.8	84.9	2.6	91.9
Ester dust	1 7/8	2.0	93.7	2.5	92.2	3.0	90.6	2.0	93.7
Sodium dust	1 7/8	2.5	92.2	2.0	93.7	1.6	95.0	2.0	93.7
Ester	2 1/2	2.2	93.1	1.8	94.3	0.5	98.4	1.5	95.3
Amine	2 1/2	1.7	94.7	1.7	94.7	2.5	92.2	2.0	93.7
Sodium	2 1/2	1.7	94.7	1.3	96.0	1.7	94.7	1.6	95.0
Ammonium	2 1/2	1.7	94.7	0	100.0	9.0	71.7	3.6	88.7
Ester dust	2 1/2	3.2	89.9	2.0	93.7	5.7	82.1	3.6	88.7
Sodium dust	2 1/2	6.7	78.9	1.8	94.3	5.8	81.8	4.7	84.3
untreated**		31.8	00.0	31.8	00.0	31.8	00.0	31.8	00.0

* Average of Duplicate treated plots

** Average of original count on 24 untreated plots.

20. Effects of three formulations of 2,4-D on field bindweed when applied at three different rates, under various growing conditions in South Dakota. Derscheid, Lyle A., and L. M. Stahler (Contributed by the Agronomy Department of South Dakota Agricultural Experiment Station and Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A.)

Treatment	Plant Counts from plots treated under adverse conditions*										Plant counts from plots treated under favorable conditions*					
	Roberts-mowed Treat.8-13-47 Count. 6-9-48		Beadle-dry Treat.7-22-47 Count.6-9-48		Edmunds-dry Treat.7-25-47 Count.6-9-48		Lyman-dry Treat.7-11-47 Count.6-11-48		Average		Clay Treat.7-3-47 Count.6-10-48		Kingsbury Treat.7-12-47 Count.6-9-48		Average	
	Plants per sq. yd.	% kill	Plants per sq.yd.	% KILL	Plants per sq.yd.	% KILL	Plants per sq.yd.	% KILL	Plants per sq.yd.	% KILL	Plants per sq.yd.	% KILL	Plants per sq. yd.	% KILL	Plants per sq.yd.	% KILL
Ester 1/4	8.1	74.0	19.0	35.0	12.5	65.3	20.0	58.0	14.9	59.7	3.0	91.6	5.3	87.5	4.2	89.3
Amine 1/4	7.1	76.9	11.9	59.3	8.0	77.8	22.5	53.0	12.4	66.5	1.0	97.2	5.0	88.2	3.0	92.3
Sodium 1/4	6.8	77.9	12.0	59.0	6.5	82.0	27.5	42.0	13.2	64.3	2.3	93.6	6.5	84.6	4.4	88.7
Ester 3/4	42.8	90.9	10.5	61.4	5.5	84.7	13.8	71.0	8.1	78.1	1.3	96.4	4.2	90.1	2.8	92.8
Amine 3/4	47.6	75.3	7.0	76.0	4.7	87.0	11.5	76.0	7.7	89.2	0.3	99.1	1.8	95.8	1.1	97.2
Sodium 3/4	46.8	77.9	12.5	57.0	7.0	80.3	23.9	50.0	12.5	66.2	0.5	98.6	5.5	87.0	3.0	92.3
Ester 1 1/4	4.1	86.7	7.8	81.3	6.3	82.5	21.0	56.0	5.1	86.2	0.3	99.0	2.5	94.1	1.4	96.4
Amine 1 1/4	5.3	82.8	5.2	83.0	6.5	82.0	9.0	81.0	6.5	82.4	0	100.0	2.4	94.3	1.2	96.9
Sodium 1 1/4	2.4	92.2	9.5	67.5	4.5	87.5	13.0	73.0	7.3	80.2	1.4	96.0	1.5	96.5	1.4	96.7
Untreated	35.2	00.0	29,2	00.0	36.0	00.0	47.5	00.0	37.0	00.0	35.8	00.0	42.2	00.0	39.0	00.0

*All plant counts are averages of two plots.

26. The effect of 2,4-D on field bindweed when used in conjunction with various cultural treatments at Scotland South Dakota. Derscheid, Lyle A. and L.M. Stahler. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering USDA.

	Bindweed counts on June 1, 1948 Three 2,4-D compounds at two rates.											
	Ester 1#		Amine 1#		Sodium 1#		Ester ½#		Amine ½#		Sodium ½#	
	Plants per sq yd	% kill	Plants per sq yd	% kill	Plants per sq yd	% kill	Plants per sq yd	% kill	Plants per sq yd	% kill	Plants per sq yd	% kill
(1) Oats & 2,4-D in 1947 Oats in 1948	1.7	94.6	2.0	93.6	1.3	95.8	--	--	--	--	--	--
(2) Oats & 2,4-D in 1947 corn in 1948	2.5	92.1	2.0	93.6	2.7	91.4	--	--	--	--	--	--
(3) Oats 2,4-D and rye fall seeded on fall plowing in 1947	1.0	96.8	0.8	97.4	1.3	95.8	--	--	--	--	--	--
(4) Cult to 7-1, 2,4-D & rye full seeded on late fall plowing in 1947	1.3	95.8	3.7	88.2	4.0	87.2	2.7	91.4	10.5	66.5	14.4	54.0
(5) Cult ot 8-1, 2,4-D & rye fall seeded in 1947	1.2	96.2	1.0	96.8	1.4	95.5	11.8	62.4	2.5	92.1	1.4	95.5
(6) Cult to 7-1 & 2,4-D in 1947. Alfalfa in 1948	28.0	10.5	18.8	40.0	26.5	15.4	26.4	15.7	25.3	19.2	25.4	18.9
(7) Cult to 7-1, 2,4-D in 1947. Brome grass in 1948	15.4	50.8	20.8	35.6	16.1	48.6	18.8	40.0	26.8	14.4	19.5	37.7
Original count average of 66 sq yard counts.	31.3	--	31.3	--	31.3	--	31.3	--	31.3	--	31.3	--

Treatment of Canada thistle and perennial Sow thistle not in growing crops, with 2,4-D. Rates and dates. Brown, D. A. A small area heavily infested with both these weeds was chosen for the tests on a farm near Forrest, some 12 miles north of the Experimental farm. Plots used were each one square rod in size. Spraying was done with a knapsack sprayer

Results are summarized in the table.

Ab. 27

Canada and Perennial Sow thistle - Forrest, Manitoba. 1948.

Stage and Date of Treatment	Conc. lb. acid per ac.	Estimated Reduction in Stand of top growth in % at time of readings Sept. 21 and Oct. 5, 1948.					
		Ester		Amine		Sodium	
		Canada Thistle	Sow Thistle	Canada Thistle	Sow Thistle	Canada Thistle	Sow Thistle
	lb.	%	%	%	%	%	%
A. Early bud, Late June	½		3		8		5
	1	15	85	20	15	6	4
	2	16	60	8	4	10	8
	3	15	75	10	5	16	10
B. Fullbloom Mid-July	½	30	85	60	70	75	80
	1	70	85	-	80		50
	2		75		80		95
	3	85		90		80	
C. Post Bloom Mid-August	½	75	80	40	25	72	30
	1	50	60	90	40	85	50
	2	60	80	85	80	75	60
	3		60		65		70

Unfortunately the infestation of both thistles was not uniform all over the area. In four sets of plots Canada thistle was not present. Sow thistle was absent in one set of plots.

The weeds were growing on a piece of land one-way disked late in 1947. No further cultivation was done until after the experiment was closed out in October 1948. Spraying was all done on pure stands not in growing crop.

Canada thistle made normal growth, but the Sow thistle refused to proceed beyond a rosette stage throughout the season.

Summary of Results:

A. Date of Treatment. Early sprayings in June gave relatively poor results. Poor kills of Canada thistle resulted. Kills of Sow thistle were better.

Spraying when Canada thistle was in full bloom resulted in killing back to the ground 60 to 80 per cent of all plants. Better kills were also

obtained with Sow thistle at this date even though plants had not developed stems.

Mid-August spraying when Canada thistle was past bloom gave slightly better kills than spraying at full bloom.

B. Rates of Applying Chemical.
The half-pound rate gave very poor results with Sow thistle at the time of the June sprayings, but reasonably good kills of above ground growth at the time of July and August sprayings. There was a slight preference in favor of the heavier rate at all dates, but in most instances one pound gave almost as good results as three pounds.

C. Regrowth.

Estimated percentage regrowth Oct. 4, 1948.

Stage and Date of Treatment	Conc. lb. acid per ac.	Ester		Amine		Sodium	
		Canada Thistle	Sow Thistle	Canada Thistle	Sow Thistle	Canada Thistle	Sow Thistle
		%	%	%	%	%	%
A. Early bud. Late June	½		85		92		98
	1	70	80	74	85	75	90
	2	70	82	75	80	76	88
	3	65	70	69	73	60	90
B. Full Bloom Mid-July	½	75	70	70	82	78	82
	1	67	63		57		73
	2		56		61		65
	3	45		48		41	
C. Post Bloom Mid-August	½	82	57	83	60	90	60
	1	62	53	68	62	82	58
	2	46	42	47	31	66	45
	3		15		21		18

At light rates in June sprayings, regrowth was very heavy by October. Examination of roots showed little killing. At light rates in July sprayings regrowth was considerable, but there was a definite increase in root killing at two and three pound rates. Mid-August sprayings at two and three pounds gave the highest percentage of root killing.

No repeated treatments were tested.

Contributed Field Husbandry Division, Dominion Experimental Farm, Brandon. Manitoba, Canada.

Summary table for per cent control of Canada thistle
Treated at 3 stages and with 3 rates of 3 2,4-D formulations
Ab. 30

Rate	Stages	Formulations (Average 6 Reps.) Sodium Salt	Amine	Ester	Rate Average
0	2" - 4" in height	0	0	0	0
3/4	"	71.7	75.8	88.2	78.6
1	"	75.3	76.7	89.2	80.4
1-1/2	"	71.7	86.2	90.8	82.9
Average		72.9	79.6	89.4	
0	6" - 8" in height	0	0	0	0
3/4	"	66.7	80.2	79.7	75.5
1	"	70.0	82.5	87.5	80.0
1-1/2	"	78.3	88.7	91.7	86.2
Average		71.7	83.8	86.3	
0	Early Bud	0	0	0	0
3/4	"	71.7	75.2	83.3	76.7
1	"	70.8	77.5	87.5	78.6
1-1/2	"	80.0	74.2	90.0	81.4
Average		74.2	75.6	86.9	
Formulation Average		72.9	79.7	87.5	
M.S.D. for formulations		$^{xx}8.43\%$			
M.S.D. for rates		$^{xx}2.47\%$			

Contribution Leggett, H. W., Experimental Farms, Field Husbandry Division, Lacombe, Alberta, Canada.

Effect of various systemic (hormone) chemicals of Canada thistle, 8 inches high. Applied at different rates and in different combinations. Pavlychenko, Thomas K. American chemical Paint Co. Saskatoon, 1948.

Ab. 31

Chemicals	Rates	Original Top Growth			New Shoots				
		Per cent		Days after	Per cent			Height	
		Curled	Died	treat.	Of Orig. Stand	Produced Buds	Died	of Surv. Shoots	Roots
We. 48	8	100	100	34	64	28	0	7-14	Healthy
We.48	16	100	100	32	49	10	0	6-11	Healthy
We.48	24	100	100	32	37	7	0	4-11	Healthy
We.48	32	100	100	30	28	5	0	4-10	Healthy
W #5	8	100	100	38	25	4	8	4-9	Healthy
W #5	16	100	100	34	7	0	13	2-7	Damaged
W #5	24	100	100	32	8	0	0	2-8	Damaged
W #5	32	100	100	32	5	0	15	2-3	Serious damage
LFN 549	8	100	100	41	60	36	0	8-14	Healthy
LFN 549	16	100	100	41	51	32	0	8-14	Healthy
LFN 549	24	100	100	36	38	10	0	6-11	Healthy
LFN 549	32	100	100	34	31	10	0	8-11	Healthy
LFN 549	40	100	100	32	32	5	0	5-10	Healthy
LFN 549	48	100	100	32	9	0	Sick	5-8	Damaged
We.48/W#5	8/8	100	100	35	19	0	0	4-8	Damaged
We.48/W#5	16/8	100	100	32	23	0	0	5-10	Damaged
We.48/W#5	8/16				12	0	24	2-9	V.S.Damaged
We.48/W#5	16/16	100	100	30	7	0	15	2-6	Damaged
We.48/LFN549	8/8	100	100	34	35	0	0	5-9	Healthy
We.48/LFN549	16/8	100	100	32	12	0	0	7-9	Healthy
We.48/LFN549	8/16	100	100	34	63	22	0	7-11	Healthy
We.48/LFN549	8/24	100	100	32	50	0	0	4-6	Healthy
We.48/LFN549	16/16	100	100	30	36	0	0	6-9	Healthy
We.48/LFN549	16/24	100	100	30	23	0	Weak	4-7	Healthy
W#5/LFN549	8/8	100	100	38	30	0	0	5-9	Healthy
W#5/LFN549	16/8	100	100	35	8	0	V.Weak	3-7	Damaged
W#5/LFN549	8/16	100	100	38	45	8	0	7-13	Healthy
W#5/LFN549	8/24	100	100	34	14	2	Weak	6-9	Healthy
W#5/LFN549	16/16	100	100	33	12	0		5-10	Serious damage
W#5/LFN549	16/24	100	100	30	10			3-8	Damaged
Controls	0	---	---	--	128 sq. yd	-	--	--	---

We.48 - Weedone Concentrate 48. ethyl ester; LFN549 - ester of 2,4,5-T; W#5 - Weedone #5 ethyl ester.

Results of 2,4-D materials in the control of Canada thistle. Slife, F. W. and R. F. Fuelleman. Replicated square rod plots of Canada thistles were treated with 1/4, 3/4 and 3 pounds of acid per acre in the ester and amine forms, and 1/2, 1 and 4 pounds of acid in the sodium salt form of 2,4-D. Plots were sprayed May 5 and again on July 7, 1948. On both dates, spraying was done at the pre-bud stage of growth. Thistle shoot counts made before spraying indicated that there were 10 thistle shoots per square foot. Counts made after spraying are given in the following table in percentages of the original population.
Ab. 34

Formulation	Rate lbs. acid per acre	Regrowth in per cent of May 1st population All plots sprayed May 5, July 7, 1948 May 5	July 6	Oct. 1
Ester	1/4	100	87.8	79.4
	3/4	100	65.2	47.6
	3	100	61.3	16.7
Amine	1/4	100	90.5	75.1
	3/4	100	73.4	43.3
	3	100	56.2	8.7
Salt	1/2	100	86.2	79.0
	1	100	79.0	59.1
	4	100	64.6	40.4
Check	0	100	107.0	123.0

The majority of these plots were located in a heavy bluegrass sod; however, one replication of the amine preparation, at the three pound rate, was situated in an area without sod covering. This probably accounts for the better showing of the amine preparation. Observations this year on other perennial weeds bear out this point and in no case were kills as good in sodded as in areas without sod cover. Apparently, coverage and penetration are governing factors. Other plots of Canada thistles sprayed in the pre-bloom stage seemed more resistant, and results indicate that better control is attained by pre-bud applications.

Applications of 2,4-D made in September to previously mowed thistles with two pounds of acid per acre in the amine form have been effective in killing top growth, but regrowth, as of October 10, indicates that there was very little if any reduction in stand. Observation will be continued in 1949 on these fall applications. (Contribution of Ill. Agr. Exp. Sta.)

Summary of the results of Herbicides applied to Canada thistle. Miller, John H., St. Paul, Minnesota. 1948.

Ab. 35

	Na. Salt 2,4-D	Amine Salt 2,4-D	Ester 2,4-D	2,4,5-T	Ave.
Stages of growth	(uniform conc. 1 pound of acid per acre.)				
Spring rosette	72.99	79.60	87.85	56.25	74.17
Bud stage	57.73	75.95	65.56	48.15	61.85
Fall growth	18.50	40.95	20.20	23.08	23.18
Ave.	49.74	65.50	57.87	42.74	
Concentrations (Uniform bud stage of growth.)					
.5 pound	59.17	58.07	32.45	67.00	51.67
1 pound	57.73	75.95	65.56	48.15	61.85
1.5 pound	77.67	81.50	91.90	75.00	81.52
2 pounds	78.27	63.55	72.59	56.25	67.67
Ave.	68.21	69.77	65.62	61.60	

*First year treatment whereas other treatments are repetitions of 1947 treatments.

The effect of treating Canada thistle in Butte county with 2,4,5-T and three formulations of 2,4-D at four rates of application. Derscheid, Lyle A., and D. E. Kratochvil. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station.)
Ab. 38

Treatment	Lbs. of 2,4-D acid per acre	Plant counts made on September 14, 1948 after treatments were applied June 18, 1948. Live plants per sq. yard	Per cent killed
Ester	1/2	8.75	77.1
Amine	1/2	10.75	71.9
Sodium	1/2	9.25	75.9
2,4,5-T	1/2	19.50	49.1
Ester	3/4	8.25	78.4
Amine	3/4	9.00	76.5
Sodium	3/4	5.25	86.3
2,4,5-T	3/4	21.50	43.8
Ester	1	6.00	84.3
Amine	1	5.75	85.0
Sodium	1	4.50	88.2
2,4,5-T	1	11.75	69.3
Ester	1 1/2	3.75	90.2
Amine	1 1/2	5.25	86.3
Sodium	1 1/2	5.00	86.1
2,4,5-T	1 1/2	13.75	64.1
Untreated	--	38.25	00.0

The effect of treating Canada thistle in Lawrence county with 2,4,5-T and two formulations of 2,4-D at three rates of application. Derscheid and D. E. Kratochvil. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station.)
Ab. 39

Treatment	Lbs. of acid per acre	Plant counts made on September 18, 1948 after treatments were applied June 19, 1948. Live plants per square yd.	Per cent killed
Ester	3/4	2.0	92.7
Amine	3/4	4.7	82.9
2,4,5-T	3/4	8.3	69.2
Ester	1	2.0	92.7
Amine	1	3.5	87.3
2,4,5-T	1	8.7	68.4
Ester	1 1/2	3.5	87.3
Amine	1 1/2	4.2	84.7
2,4,5-T	1 1/2	9.0	67.3
Untreated	--	27.5	00.0

The effect of treating and retreating Canada thistle in Roberts county with three formulations of 2,4-D at three rates of application. Derscheid, Lyle A., L. M. Stahler, and D. E. Kratochvil. (Contribution by the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering.)

Ab. 41

Treatment	Lbs. of 2,4-D acid per acre	Plant Count: After 1 treatment made July 8, 1947 counted Sept. 8, 1947 — Live Plants per sq. yd.	After 1 treatment made July 8, 1947 counted Sept. 8, 1947 — Per cent killed	After 2 treatments made July 8 & Sept. 8, 1947 counted June 8, 1948 — Live Plants per sq. yd.	After 2 treatments made July 8 & Sept. 8, 1947 counted June 8, 1948 — Per cent killed	After 3 treatments on July 8, Sept. 8 & June 8 counted Sept. 15, 1948. — Live Plants per sq. yd.	After 3 treatments on July 8, Sept. 8 & June 8 counted Sept. 15, 1948. — Per cent killed
Ester	1/4	8.2	74.2	8.1	74.0	5.3	82.0
Amine	1/4	9.2	71.0	7.1	76.9	5.5	82.3
Sodium	1/4	5.9	81.4	6.8	77.9	4.0	87.1
Ester	3/4	3.7	88.3	2.8	90.0	1.7	94.5
Amine	3/4	2.3	92.8	7.6	75.3	2.7	91.3
Sodium	3/4	3.6	88.9	6.8	77.9	1.3	95.8
Ester	1-1/4	4.2	86.8	4.1	86.7	2.7	91.3
Amine	1-1/4	1.9	94.0	5.3	82.8	2.1	93.2
Sodium	1-1/4	1.9	94.0	2.4	92.9	1.3	95.8
Untreated	---	31.7	00.0	30.7	00.0	31.0	00.0

Effect of treating and retreating Canada thistle in Grant county with three formulations of 2,4-D at three rates of application. Derscheid, Lyle A., L. M. Stahler, and D. E. Kratochvil. (Contributed by the South Dakota Agricultural Experimer Station and Bureau of Plant Industry, Soils and Agricultural Engineering.)

Ab. 40

Treatment	Lbs. of 2,4-D acid per acre	Plant Count: After 1 treatment treated July 8, 1947 counted Sept. 8, 1947 — Live Plants per sq. yd.	After 1 treatment treated July 8, 1947 counted Sept. 8, 1947 — Per cent killed	After 2 treatments made July 8 & Sept. 8, 1947 counted June 8, 1948 — Live Plants per sq. yd.	After 2 treatments made July 8 & Sept. 8, 1947 counted June 8, 1948 — Per cent killer	After 3 treatments on Sept. 8 & July 10, 19.8 counted Sept. 15, 1948 — Live Plants per sq. yd.	After 3 treatments on Sept. 8 & July 10, 19.8 counted Sept. 15, 1948 — Per cent killed
Ester	1/4	11.2	60.0	11.5	59.0	8.3	71.4
Amine	1/4	4.0	85.7	3.6	87.1	6.2	78.6
Sodium	1/4	11.2	60.0	4.8	82.9	6.3	78.3
Ester	3/4	7.7	72.5	6.1	78.2	3.2	89.0
Amine	3/4	4.2	85.0	2.6	90.7	3.2	89.0
Sodium	3/4	0.9	96.8	2.3	91.8	3.3	88.8
Ester	1-1/4	4.7	83.2	4.5	84.0	2.2	92.4
Amine	1-1/4	3.3	88.2	1.6	94.3	2.5	91.4
Sodium	1-1/4	1.5	94.7	1.9	93.2	2.3	92.1
Untreated	---	28.0	00.0	28.0	00.0	29.0	00.0

Effectiveness of three preparations of 2,4-D used at three rates in controlling Canada thistle (Circium arvense). Buchholtz, K. P. (Dept. Agronomy, Univ. of Wisconsin, Madison, Wisconsin).

Ab. 42

Preparation	Application Lbs./Acre	Per cent shoot reduction		
		Treatment Ave.	Material Ave.	Application Ave.
2,4-D as the sodium salt	1.0	66.5	74.8	66.3
" " " " "	2.0	70.7		76.8
" " " " "	4.0	87.1		85.7
2,4-D as the amine	1.0	61.8	74.7	
" " " "	2.0	73.1		
" " " "	4.0	89.1		
2,4-D as the butyl ester	1.0	70.0	77.1	
" " " " "	2.0	86.7		
" " " " "	4.0	74.6		
Check	---	+51.6	---	---

Use of 2,4-D in control of Canada thistle (Cirsium arvense) Bohmont, Dale W.
University of Wyoming, Agronomy Department.
Ab. 43

Concentration	Material Counts on Per cent Survival			
	Ester	Amine	Salt	No Treatment
1/4 pound	128.0	116.6	88.7	
3/4 pound	99.4	74.9	101.5	
1-1/4 pound	113.3	73.7	148.4	
2 pounds	160	29.7	106.2	
Check				107.7
Average all Concentration	125.2	73.7	111.2	

Variation Due to	D.F.	Sx^2	$\bar{x}$		F.
Blocks	1	303.89	303.89		
Treatment	11	26,957.67	2,450.69		1.27
Material	2	11,326.32	5,663.16		2.93
Concentration	3	1,707.70	569.23		
Error	6	11,596.81	1,932.78	43.95	
Total	23	51,892.29			

Standard Error of the Mean Difference - 43.95

Treatment		Rep. I	Rep. II	Summary	Average % Survival
Ester	1/4 pound	76.0	180.	256.0	128.0
Amine	3/4 "	73.9	75.9	149.8	74.9
Na Salt	1-1/4 "	96.9	200.	296.9	148.4
Ester	1-1/4 "	73.3	153.3	226.6	113.3
Amine	1-1/4 "	100.	47.4	147.4	73.7
Na Salt	3/4 "	128.6	74.4	203.	101 5
Amine	2 "	30.8	28.6	59.4	29 7
Ester	3/4 "	87.0	111.7	198.7	99 1
Amine	1/4 "	118.8	114.3	233.1	116.6
Na Salt	2 "	92.3	120.	212.3	106.2
Check		100.	115.4	215.4	107 7
Ester	2 "	220.	100.	320.	160.
Na Salt	1/4 "	100.	77.4	177.4	88.7
Total		1297.6	1398.4	2696.0	

The use of 2,4-D in control of hoary cress (Lepidium draba) Bohmont, D. W.
Wyoming Agricultural Experiment Station, Laramie, Wyoming.

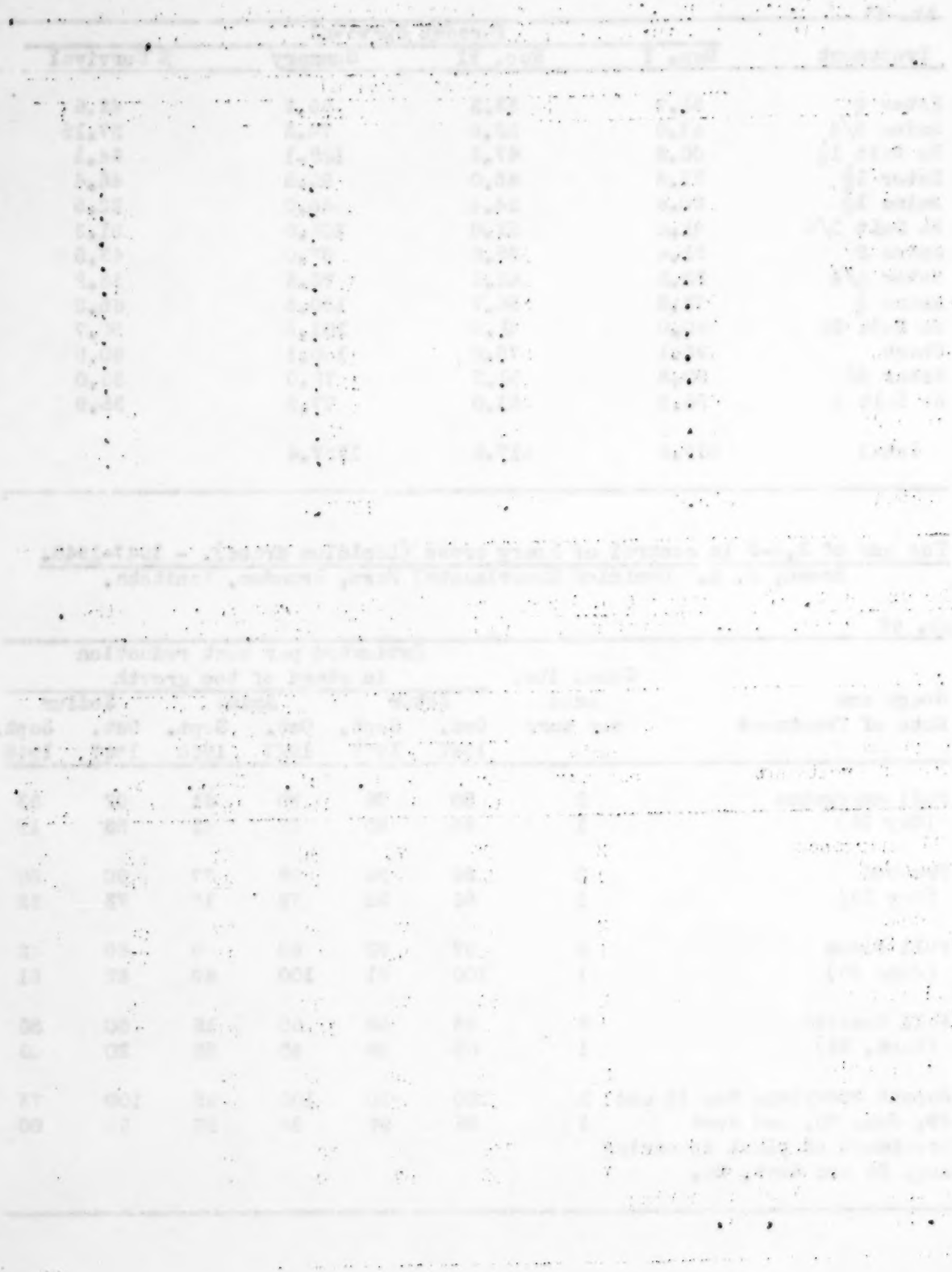
Ab. 45

Treatment	Percent Survival Rep. I	Rep. II	Summary	% Survival
Ester ¼	51.9	33.3	85.2	42.6
Amine 3/4	41.8	32.5	74.3	37.15
Na Salt 1¼	80.8	47.3	128.1	64.1
Ester 1½	31.8	65.0	96.8	48.4
Amine 1½	20.6	24.4	45.0	22.5
Na Salt 3/4	41.6	61.0	102.6	51.3
Amine 2#	51.4	35.6	87.0	43.5
Ester 3/4	33.3	43.1	76.4	38.2
Amine ¼	73.8	56.7	130.5	65.3
Na Salt 2#	60.0	41.5	101.5	50.7
Check	85.1	75.0	160.1	80.5
Ester 2#	20.8	51.2	72.0	36.0
Na Salt ½	26.9	51.0	77.9	35.9
Total	619.8	617.6	1237.4	

The use of 2,4-D in control of hoary cress (Lepidium draba). - 1947-1948.
Brown, D. A. Dominion Experimental Farm, Brandon, Manitoba.

Ab. 46

Stage and Date of Treatment	Conc. lbs. acid per acre	Estimated per cent reduction in stand of top growth: Ester Oct. 1947	Ester Sept. 1948	Amine Oct. 1947	Amine Sept. 1948	Sodium Oct. 1947	Sodium Sept. 1948
Full emergence (May 16)	2	90	76	80	61	92	63
	1	85	60	62	42	58	12
Pre-bud (May 29)	2	82	76	92	77	90	56
	1	86	58	79	12	73	32
Full Bloom (June 20)	2	97	72	89	9	69	42
	1	100	91	100	69	82	51
Fall Rosette (Sept. 26)	2	85	68	60	16	30	36
	1	65	48	40	52	20	46
Repeat sprayings May 16 and 29, June 20, and spot treatment of plant appearing Aug. 26 and Sept. 26.	2	100	90	100	95	100	73
	1	95	97	94	90	94	80



PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS

Tabular Data

Investigation III-6. Use of 2,4-D as a Selective Herbicide in Controlling Weeds in Legumes Seeded With Wheat, Oats or Barley

Ab. 1
Response of red clover and alfalfa seedlings to three preparations of 2,4-D applied at several rates. Buchholtz, K. P. (Dept. Agronomy, Univ. of Wis., Madison, Wisconsin).

2,4-D preparation	Application Lbs./acre	% check stand	
		Red clover	Alfalfa
Sodium salt	0.25	100	100
	0.5	109	89
	1.0	98	68*
	2.0	100	46**
Amine	0.25	100	94
	0.5	100	73*
	1.0	100	73*
	2.0	60**	42*
Butyl ester	0.125	115	95
	0.25	117	95
	0.5	93	37**
	1.0	44**	11**
	2.0	6**	0**
L.S.D. - 5% level		29	27
1% level		38	36
Check - plants/sq. ft.		8.4	8.8

Tentative Data

Effect of 2,4-D and Dow Selective as selective herbicides on legumes seeded with oats. Taylor, D. K., Agassiz, B.C. - 1948.
Ab. 2

Treatment	Clover survival (plant count 1 sq.yd. at harvest)									
	Growth stage 1					Growth stage 2				
	1	2	3	Av.	% Check	1	2	3	Av.	% Check
Sodium 1/4 lb.	55	89	163	102	39.7	21	128	76	75	42.1
" 1/2 lb.	64	110	41	72	28.0	44	94	82	73	41.0
" 3/4 lb.	53	105	138	99	38.5	28	26	34	29	16.3
" 1 lb.	48	22	6	25	9.7	4	1	36	14	7.9
Amine 1/2 lb.						26	49	75	50	28.1
" 1 lb.						2	6	13	7	3.9
Ester 1/4 lb.	99	105	89	98	38.1	27	36	25	29	16.3
" 1/2 lb.	12	62	74	49	19.1	30	14	32	25	14.0
" 3/4 lb.	1	31	19	17	6.6	8	13	26	16	9.0
" 1 lb.	3	3	58	21	8.2	6	6	3	5	2.8
Dow Selection 3 pt.	61	80	84	75	29.1	66	26	37	43	24.1
Check	90	300	380	257	100.0	48	285	200	178	100.0

N.B.
Growth stage 1 - May 26, oats 5-7", clover 1/2", hand sprayer.
Growth stage 2 - June 2, oats 10", clover 1/2-2 1/2", applied with boom sprayer and low volume nozzles.

Response of red clover and biennial sweet clover to 2,4-D when seeded as undercrops to Mindo oats. Miller, J. H., U.S.D.A.
Ab. 4

Per cent survival observed in the fall

Formulation	Rate in	Development of oats at treatment			
		Tillering stage	Shooting stage	Heading stage	After harvest
Check		69	85	84	100
Na salt	1/16	86	73	86	51
	1/8	57	85	60	52
	1/4	39	48	71	64
	av.	61	67	72	56
Amine salt	1/16	44	87	73	69
	1/8	58	81	66	79
	1/4	76	79	66	44
	av.	59	82	68	64
Ester	1/16	60	46	48	67
	1/8	84	93	77	99
	1/4	68	64	15	54
	av.	71	68	47	73
Av. all formulations		64	72	62	64
	av. 1/16	63	69	69	62
	av. 1/8	66	86	68	77
	av. 1/4	61	64	51	54

Response of red clover and alfalfa seedlings to growth regulation and dinitro herbicides. Buchholtz, K. P. (Dept. Agronomy, Univ. of Wis., Madison, Wisconsin)

Ab. 6

Material	Rate of application	Stand as per cent of check	
		Red clover	Alfalfa
2,4-D as the ethyl ester	1 lb/acre	11**	3**
" " " isopropyl ester	"	30**	11**
" " " butyl ester	"	17**	6**
" " " sodium salt	"	115	70
" " " ammonium salt	"	94	67*
" " " amine (Dow)	"	73	53**
" " " " (Powell)	"	16**	24**
" " " " (A.C.P.)	"	68	23**
2,4,5-T as the isopropyl ester	"	4**	10**
MCP " " " "	"	144**	13**
DNOSPB as the ammonium salt	1 gal./acre (80 gal.water)	100	159**
"	1 gal./acre (40 gal.water)	94	154**
"	1 gal./acre (20 gal.water)	100	143**
Check - plants/sq. ft.		6.6	6.8
L.S.D. at the 5 per cent level		32 pct.	30
" " " 1 " " "		43	43

PROJECT III. EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS

Tables of Results of Individual Cooperators

Spring oats, Wheat and Barley.

7. The Effect of 2,4-D on Clinton Oats, Columbus, Ohio, 1948. (Contributed by Warren C. Shaw and C. J. Willard, Ohio Agric. Exp. Station.)

Material, date of treatment and state of growth	Yield of oats per acre after treating with 2,4-D at 0 lb. (Check)	1/4 lb. per acre	1/2 lb. per acre	1 lb. per acre	Av. of treated plots
	Bu.	Bu.	Bu.	Bu.	Bu.
April 24, at emergence					
Amine salt	53.3	39.8	45.0	39.2	41.3
Butyl ester	34.1	49.9	47.2	42.8	46.6
May 5, 1 week after emergence					
Amine salt	25.2	34.1	38.5	40.4	37.7
Butyl ester	43.1	30.7	28.5	26.7	28.6
May 8, 2 weeks after emergence					
Amine salt	41.2	38.1	30.3	31.8	33.4
Butyl ester	56.5	30.5	34.1	49.1	37.9
May 18, 3 weeks after emergence					
Amine salt	39.6	48.3	39.3	36.8	41.5
Butyl ester	29.7	48.8	41.8	41.5	44.0
May 22, just before jointing					
Amine salt	31.2	33.8	37.5	44.9	38.7
Butyl ester	40.0	45.5	30.7	31.4	35.9
May 29, culms 3-6" tall					
Amine salt	22.0	36.6	42.9	38.5	39.3
Butyl ester	39.5	34.8	45.7	39.8	40.1
June 22, heading					
Amine salt	40.8	35.5	27.4	39.2	34.0
Butyl ester	46.9	43.6	41.6	34.2	39.8
June 30, blooming					
Amine salt	34.5	50.0	35.4	39.8	41.7
Butyl ester	39.8	42.3	35.4	46.6	41.4
July 9, milk stage					
Amine salt	46.4	45.9	32.9	43.4	40.7
Butyl ester	51.9	39.3	39.4	43.4	40.7
Av. all stages					
Amine salt					38.7
Butyl ester					39.5
Checks	39.7				

8. Effect of 2,4-D on Yield of Clinton Oats, at the Pre-joint Stage, Columbus, Ohio. (Contributed by Warren C. Shaw and C. J. Willard, Ohio Agric. Exp. Station).

Rates 2,4-D acid per acre	Yield per acre, following treatment with Triethanol amine salt	Sodium salt	Butyl ester	Average all materials
Lb.	Bu.	Bu.	Bu.	Bu.
Check 0	52.6	52.0	53.6	52.7
½	54.0	49.9	47.6	50.5
1	56.1	48.2	55.2	53.2
1½	53.2	50.3	52.5	52.0
2	50.7	60.4	52.0	54.4
4	54.2	54.7	44.6	51.2
Av. all rates	53.6	52.7	50.4	52.3

9. Spraying oats with 2,4-D. Goodwin, H.*, F. W. Slife, and R. F. Fuelleman. (Contribution of Illinois Agricultural Experiment Station.)

	Yield Bu./Acre	Ave. Bundle wt. per sq. yd. samples - gms.	Ave. Straw length per sq. yd. Samples - inches	Ave. no straws per sq. yd. sample
CLINTON				
(sprayed)	87.4	753	41.5	214
(unsprayed)	77.1	603	39.0	156
MINDO				
(sprayed)	76.7	722	36.7	282
(unsprayed)	73.0	533	36.0	178
CLINTON 11				
(sprayed)	83.4	591	40.5	187
(unsprayed)	71.0	573	39.0	174

* Funk Bros. Seed. Co.

10. Effect of herbicidal applications of growth regulating substances and dinitro materials on the grain yield, seed germination, spikelet number and kernel weight of oats. Buchholtz, K. P. (Dept. of Agronomy, University of Wisconsin, Madison, Wisconsin.)

Material	Grain Yield Bu./Acre	Seed Germination Per cent	Kernel Wt. gms./100	Spikelet Number
2,4-D as the ethyl ester	98.8	91.4	2.67	20.6
2,4-D as the isopropyl ester	104.8	97.7	2.60	22.4
2,4-D as the butyl ester	93.4*	93.5	2.60	21.7
2,4-D as the sodium salt	105.2	97.1	2.63	20.2
2,4-D as the ammonium salt	108.1	95.1	2.68	22.5
2,4-D as the amine (Dow Chemical Co.)	104.1	95.7	2.63	20.5
2,4-D as the amine (J. C. Powell Co.)	107.7	96.8	2.63	21.0
2,4-D as the amine (Amer.Chem.Paint Co.)	105.8	94.6	2.64	20.6
2,4,5-T as the isopropyl ester	105.7	93.4	2.71	18.8
MCP as the isopropyl ester	107.1	94.0	2.62	20.0
DNOSBP as the ammonium salt- 80 gals./acre	92.7*	96.5	2.36**	21.6
40 gals./acre	67.5**	95.1	2.05**	20.0
20 gals./acre	64.8**	95.2	1.93**	20.0
Check	108.2	97.4	2.65	21.8
L. S. D. at the 5 per cent level	14.0	N. S.	.10	N.S.
L.S.D. at the 1 per cent level	18.8		.14	

11. The effect of 2,4-D formulations on the yield of oats when applied to one variety at 3 stages of growth in 1946 and none varieties at 4 stages of growth in 1947 and 1948 at Scotland, South Dakota. Derscheid, Lyle A., L. M. Stahler and D. E. Kratochvil. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of plant Industry, Soils and Agricultural Engineering, U.S.D.A.).

Analysis of variance

Source of variation	d f			F value		
	1946	1947	1948	1946	1947	1948
Stages of growth	2	3	3	2.54	1.01	1.90
Replication	1	2	2	---	--	--
Error A	2	6	6	---	--	--
Treatments	3	3	3	25.13**	2.92	9.73**
Treats X stage	6	9	9	---	2.67*	2.91*
Error B	9	24	24	---	--	--
Varieties	--	8	8	---	22.57**	30.65**
Var. X stages	--	24	24	---	--	--
Var X treat.	--	24	24	---	--	1.34
Var. X Treat X Stage	--	72	72	---	--	1.01
Error C	--	256	256	---	--	--
Total	23	431	431	---	--	--

* Significant at 5% level ** Significant at 1% level.

Minimum Level of Significance for 1946

Stages of Growth	Bushels per acre Treatments			
	Ester	Amine	Sodium	Untreated
Heading	43.55	42.50	43.55	45.25
Headed	45.85	40.55	41.50	47.70
Dough	36.40	35.85	36.30	44.50
Average (1)	41.90	39.80	40.45	45.82*

(1) L. S. D. for treatments in 3.1 at 5% level and 4.5 at 1% level
* Significantly higher than any other treatment.*.

Minimum Level of Significance for 1947

Stages of Growth	Bushels per acre Treatments			
	Ester	Amine	Sodium	Untreated
Seedling	44.6	48.2	54.0**	46.4
Tillered	41.8*	45.9	44.0	49.1
Heading	45.7	48.7	50.3	46.6
Headed	48.1	47.3	50.2	51.4

(1) L. S. D. for treatment at various stages of growth is 6.6 at 5% level and 8.9 at 1% level.
* Significantly lower than untreated at same stage of growth.
** Significantly higher than untreated at same stage of growth.

(CONTINUED)

III.

Minimum Level of Significance in 1948

Stage of Growth	Bushels per acre Treatments			
	Ester	Amine	Sodium	Untreated
Seedling	32.7*	42.5	41.6	45.7
Tillered	31.1*	43.0	43.6	43.4
Heading	41.7	42.1	44.8	44.2
Headed	43.8	41.6	45.4	42.6
Average (1)	37.3**	42.3	43.9	44.0

(1) L. S. D. for treatments is 2.9 at 5% level and 4.0 at 1% level.
(2) L. S. D. for treatments x stage is 5.8 at 5% level and 7.8 at 1 % level.
* Significantly lower that other treatments at same stage and significantly lower than same treatments at other stages.
** Significantly lower than any other treatment at 5% level.

12. The Use of 2,4-D for the Control of Stinkweed in Oats, A. C. Carder, (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

FORMULATION	Rate 2,4-D acid equivalent	Average yield two sets		Average weed kill two sets	
		1st Application	2nd Application	1st Application	2nd Application
	Ounces/Acre	bu.	bu.	%	%
Sodium salt	check	83.1	74.9	0	0
	2	82.3	81.7	18	18
	4	99.0	72.8	35	33
	8	104.4	82.9	60	58
	12	93.9	72.7	70	68
	16	93.3	90.7	83	85
Amine	check	64.7	78.7	0	0
	2	80.5	70.0	28	28
	4	78.3	87.3	55	65
	8	66.1	86.1	80	83
	12	69.9	73.1	95	85
	16	50.8	66.3	97	90
Ester	check	77.3	76.8	0	0
	2	77.3	92.1	83	83
	4	58.9	63.8	93	93
	8	56.9	40.2	95	98
	12	41.3	28.3	100	100
	16	36.7	28.7	100	100

13. Effect of various 2,4-D formulations sprayed at 3 different growth stages with 5 different rates of Earle Oats, Legrett, H. W. (Contributed by Dominion Experimental Farms, Field Husbandry Division, LaCombe, Alberta Canada)

Rate	Formulation	Stages (Average 3 Reps) 1	2	3	Rate Average
0	Sodium Salt	125.8	120.3	118.9	121.7
1/8	"	116.7	115.8	109.2	113.9
1/4	"	116.4	112.5	102.6	110.5
1/2	"	113.2	108.5	100.1	107.3
3/4	"	107.3	106.6	99.4	104.4
1	"	98.2	90.5	85.9	91.5
Average		112.9	109.0	102.7	
0	Amine	132.1	118.1	116.8	121.1
1/8	"	112.2	107.0	109.7	109.6
1/4	"	111.4	101.0	102.4	104.9
1/2	"	108.9	89.6	92.9	97.1
3/4	"	106.8	86.0	92.1	95.0
1	"	95.6	78.2	85.1	86.3
Average		111.2	96.7	99.8	
0	Ester	125.6	114.3	111.3	117.1
1/8	"	111.3	105.0	100.2	105.5
1/4	"	113.8	102.7	99.8	105.4
1/2	"	106.3	82.1	80.3	89.6
3/4	"	97.2	69.3	66.7	77.7
1	"	96.3	47.8	58.4	67.5
Average		108.4	86.9	86.2	
Stage Average		110.8	97.5	96.2	

M. S. D. for ^{x}STAGES 20.21 bushels.

M. S. D. for ^{xx}RATES 6.58 bushels.

III.

14. The effect of 2,4-D on oats when applied at several stages of growth at Ante Ann de al Pocatiere. Godbout, Eugene. (Contributed by the Dominion Experimental Farm at Ste de la Pocatier, Quebec, Canada.)

Types of 2,4-D	Rates Amount of acid per acre	Yield per acre of Erban Oats treated at different growth stages. Three leaf stage av. for 3 replications	Five leaf stage av. for 3 rep.	Shot-blade stage av. for 3 rep.	Average yield per acre of each type of 2,4-D for the 3 stages	Strength of straw on (10)	Maturity No. of days
Salt	(lbs.)	bushels	bushels	bushels	bushels		
Weed-bane (Amine type)	1/8	54.9	51.8	58.1		10	87
Weed-bane (amine type)	1/4	53.4	53.4	54.9		10	97
Weed-bane (Amine type)	1/2	53.4	61.2	56.5		10	97
Weed-bane (Amine type)	3/4	53.4	58.1	59.6		10	100
Weed-bane (Amine type)	1	56.5	61.2	50.2		10	100
Check	Nil	58.1	58.1	47.1		10	97
Average for each stage		54.95	57.3	54.4	55.6		
Weed-no-more (ester type)	1/8	56.5	56.5	54.9		10	97
Weed-no-more (ester type)	1/4	51.8	48.7	54.9		10	97
Weed-no-more (ester type)	1/2	51.8	51.8	56.5		10	97
Weed-no-more (ester type)	3/4	50.2	48.7	67.5		10	100
Weed-no-more (ester type)	1	50.2	51.8	48.6		10	100
Check	Nil	58.1	58.1	47.1		10	97
Average for each stage		53.1	52.6	54.9	53.5		
Herbate (sodium salt)	1/8	51.8	58.1	47.1		10	97
Herbate (sodium salt)	1/4	59.6	62.8	70.6		10	97
Herbate (sodium salt)	1/2	58.1	58.1	51.8		10	97
Herbate (sodium salt)	3/4	61.2	61.2	62.8		10	97
Herbate (sodium salt)	1	58.1	59.6	61.2		10	97
Check	Nil	58.1	58.1	47.1		10	97
Average for each stage		57.8	59.7	56.8	58.1		
Average of all types of 2,4-D for each stage		55.3	56.5	55.4			

III.

15. The effect of 2,4-D on oat varieties. Godbout, Eugene.
(Contributed by the Dominion Experimental Farms at Ate. Anne de la Pocatiere, Quebec, Canada.

Types of 2,4-D	Rates Amount of acid per acre	Yield per acre of Oats treated in the three leaf stage: Ajax oats av. for 3 replications	Maturity No. of days	Erban oats Av. for 3 replications	Maturity No. of days	Yield of oats varieties treated with 2,4-D in the three leaf stage ex. in percentage of check: Ajax Oats Av. of 3 reps.	Erban Oats Average for 3 replications	Strength of straw (10)
Salt	lbs.	bushels		bushels		%	%	
Weed-bane (Amine type)	1/8	61.2	97	81.6	101	92.9	92.9	10
" " " "	1/4	59.6	97	97.2	101	90.4	110.7	10
" " " "	1/2	51.8	97	76.9	101	78.6	87.6	10
" " " "	3/4	56.5	100	75.3	104	85.7	85.8	10
" " " "	1	61.2	100	72.2	104	92.9	82.2	10
Check	Nil	65.9	97	87.8	101	100.0	100.0	10
Average for amine type		58.1		80.6		88.2	89.4	
Weed-no-more (Ester type)	1/8	53.4	97	83.1	101	81.0	89.8	10
" " " " "	1/4	59.6	97	91.0	101	90.4	98.4	10
" " " " "	1/2	64.3	100	78.4	101	97.6	84.7	10
" " " " "	3/4	53.4	100	80.0	104	81.0	86.5	10
" " " " "	1	53.4	100	75.3	104	81.0	81.4	10
Check	Nil	65.9	97	92.5	101	100.0	100.0	10
Average for ester type		56.8		81.6		86.2	90.6	

Special data for grain varieties.-

Stage of growth: Three leaf stage 6" - 7"
Date of application: June 19th 9 A.M. - 4 P.M.
Soil condition: Dry
Temperature when treated: 70
Temperature next 24 hours: Max. 69
Min. 39
1st rain after treatment: 5 days after 0".41
Cloudiness: 3/10
R. Humidity: 65%
Soil: Blue clay: pH 5.9

No lodging, no root injury.-

Applied with Knapsack sprayer 20 gallons per acre (1 pint per square rod).

Remark: For notes on head formation, refer to tables 1 and 2.

16. Effects of 2,4-D Ester on Malting Barley (olli), W. G. Corns, (Contributed by the University of Alberta, work supported by National Grain Company.)

Treatment	Stage 1		Stage 2	
	Yield Bu/A.	% Protein	Yield Bu/A.	% Protein
oz. 2,4-D equiv. per acre				
Check	63.33	16.0	60.66	16.2
3	61.10	16.0	56.33	16.1
6	60.99	15.9	62.55	16.0
9	58.99	15.8	56.66	16.2
12	-	-	54.55	16.4
16	-	-	47.22	16.9
20	-	-	48.99	16.9

	Stage 3		Stage 4	
Check	56.44	16.2	58.44	16.0
3	54.32	16.1	53.99	16.0
6	52.99	16.3	50.10	16.0
9	46.55	16.5	54.66	16.0
12	48.77	16.6	51.11	16.3
16	53.35	16.3	47.88	16.5
20	50.55	16.3	43.66	16.6

17. The effects of various 2,4-D formulations sprayed at 3 different growth stages with 5 different rates on olli barley. Legrett, H. W. (Contribution of Dominion Experimental Farms, Field Husbandry Division, LaCombe, Alberta, Canada).

RATE	FORMULATION	STAGES (average 3 reps.) 1	2	3	RATE AVERAGE
0	Sodium Salt	51.3	47.6	44.4	47.8
1/8	"	53.8	47.8	41.3	47.6
1/4	"	49.1	53.9	42.4	48.5
1/2	"	49.1	45.1	41.9	45.4
3/4	"	45.5	41.2	41.6	42.8
1	"	41.3	41.6	35.9	39.6
Average		48.3	46.2	41.2	
0	Amine	50.4	51.3	48.9	50.2
1/8	"	49.9	51.9	50.9	50.9
1/4	"	49.4	50.0	40.7	46.7
1/2	"	43.1	50.6	38.8	44.2
3/4	"	41.9	45.9	43.3	43.7
1	"	40.5	43.3	40.2	41.3
Average		45.9	48.8	43.8	
0	Ester	55.8	48.6	53.7	52.7
1/8	"	56.5	50.1	48.3	51.6
1/4	"	54.0	50.6	44.3	49.6
1/2	"	53.1	50.3	45.5	49.6
3/4	"	54.4	50.6	40.5	48.5
1	"	49.8	46.5	33.6	43.3
Average		53.9	49.5	44.3	
STAGE AVERAGE		49.4	48.2	43.1	

18. Influence of 2,4-D on Varieties of Barley, (Contirbuted by Dominion Experimental Farm, Brandon.) Manitoba, Canada 1948.

Variety	Dosage lb. acid per acre	Yield per acre bush.	Length Straw in.	Strength Straw 0-10	Yield per acre bush.	Length Straw in.	Strength Straw 0-10	Yield per acre bush.	Length Straw in.	Strength Straw 0-10	Yield per acre bush.	Length Straw in.	Strength Straw 0-10
Vantage	1/8	68.8	33.5	8	73.7	33.5	7.5	68.7	33	8	67.8	33	8
Vantage	1/4	67.1	33.5	6.5	69.1	33.5	8	70.0	33.5	7	67.7	33	7
Vantage	1/2	70.3	33.8	6	76.6	33.5	6.5	61.9	32	6	76.0	33	8
Vantage	3/4	68.9	33.0	5.5	78.7	31.6	5.5	67.0	31.8	5.5	69.5	33.5	8
Vantage	1	67.8	32.7	5	69.5	31.4	5	61.3	31.7	3	65.0	33.5	7.5
Average		68.6	33.3	6.2	73.5	32.7	6.5	66.0	32.4	5.9	69.2	33.3	7.7
Montcalm	1/8	67.3	34.3	7.5	67.8	34.5	8	68.1	34.3	7	69.9	36	7
Montcalm	1/4	67.7	34.7	6	67.6	35.7	7	69.2	34.3	5	68.5	35.3	7
Montcalm	1/2	69.8	33.5	6	65.9	35.8	6	66.1	33.4	4.5	69.1	35	6
Montcalm	3/4	69.6	33.5	5	75.0	33.5	6	66.6	33.3	3	69.0	35	7
Montcalm	1	68.0	35.5	4.5	70.4	35	4.5	64.6	33.3	2	68.2	34.8	6
Average		68.5	34.3	5.8	69.3	34.9	6.3	66.0	33.7	4.3	68.9	35.2	6.6

19 The effect of 2,4-D formulations on barley yields when applied to one variety in 1946 at three stages of growth and to eight varieties in 1947 and seven varieties in 1948 at four stages of growth at Scotland, South Dakota. Derscheid, Lyle A., L. M. Stahler, and D. E. Kratochvil. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A.).

Analysis of Variance

Source of variation	d. f.			F.		
	1946	1947	1948	1946	1947	1948
Stages of growth	2	3	3	9.96	34.52**	10.54**
Replications	1	1	2	--	--	--
Error A	2	3	6	--	--	--
Treatments	3	3	3	20.68**	5.83*	9.82**
Treat. x Stage	6	9	9	5.60*	1.72	--
Error B	9	12	24	--	--	--
Varieties	-	7	6	--	8.40**	17.88**
Var. x Stages	-	21	18	--	1.88*	2.25**
Var. x Treat.	-	21	18	--	--	2.04**
Var. x Treat. x Stages	-	63	54	--	--	--
Error C	-	112	192	--	--	--
Total	23	255	336	--	--	--

* Significant at 5% level ** Significant at 1% level

Minimum Level of Significance for 1946

Stage of Growth	Bushels per acre Treatments			
	Ester	Amine	Sodium	Ammonium
Heading	19.45	39.65	32.75	35.15
Headed	33.60	36.85	32.75	40.20
Dough	37.15	40.40	42.95	36.30
Average (1)	30.07*	38.97	36.15	37.22

(1) L.S.D, for treatments is 4.9 at 5% level and 7.0 at 1% level
* Significantly lower than any other treatment

Minimum Level of Significance for 1947

Stage of Growth	Bushels per acre Treatments				
	Ester	Amine	Sodium	Untreated	Average(2)
Seedling	26.5	25.6	31.2	31.8	28.8
Tillered	31.8	35.8	35.9	31.9	34.1**
Heading	22.5	31.4	30.1	30.2	28.5
Headed	24.8	33.5	28.9	28.6	28.9
Average (1)	26.4*	31.5	31.5	30.6	--

(1) L.S.D. for treatments is 3.1 at 5% level and 4.4 at 1% level
(2) L.S.D. for stage of growth is 2.4 at 5% level and 4.2 at 1% level.
* Significantly lower than other treatments.
** Significantly higher than other stages.

Minimum Level of Significance for 1948

Stage of Growth	Bushels per acre — Treatments				
	Ester	Amine	Sodium	Untreated	Average (1)
Seedling	24.8	29.6	30.1	34.3	29.7**
Tillered	27.1	34.7	34.0	36.6	33.1
Heading	28.8	32.6	33.6	35.0	32.5
Headed	32.1	33.8	33.6	33.5	33.2
Average (2)	28.2*	32.7	32.8	34.8	----

(1) L.S.D. for stage of growth is 1.81 at 5% level and 2.74 at 1% level.
(2) L.S.D. for treatments is 2.62 at 5% level and 3.55 at 1% level.
* Significantly lower than any other treatment at 1% level.
** Significantly lower than any other stage at 1% level.

Minimum Level of Significance for Varietal response at 4 stages of growth.

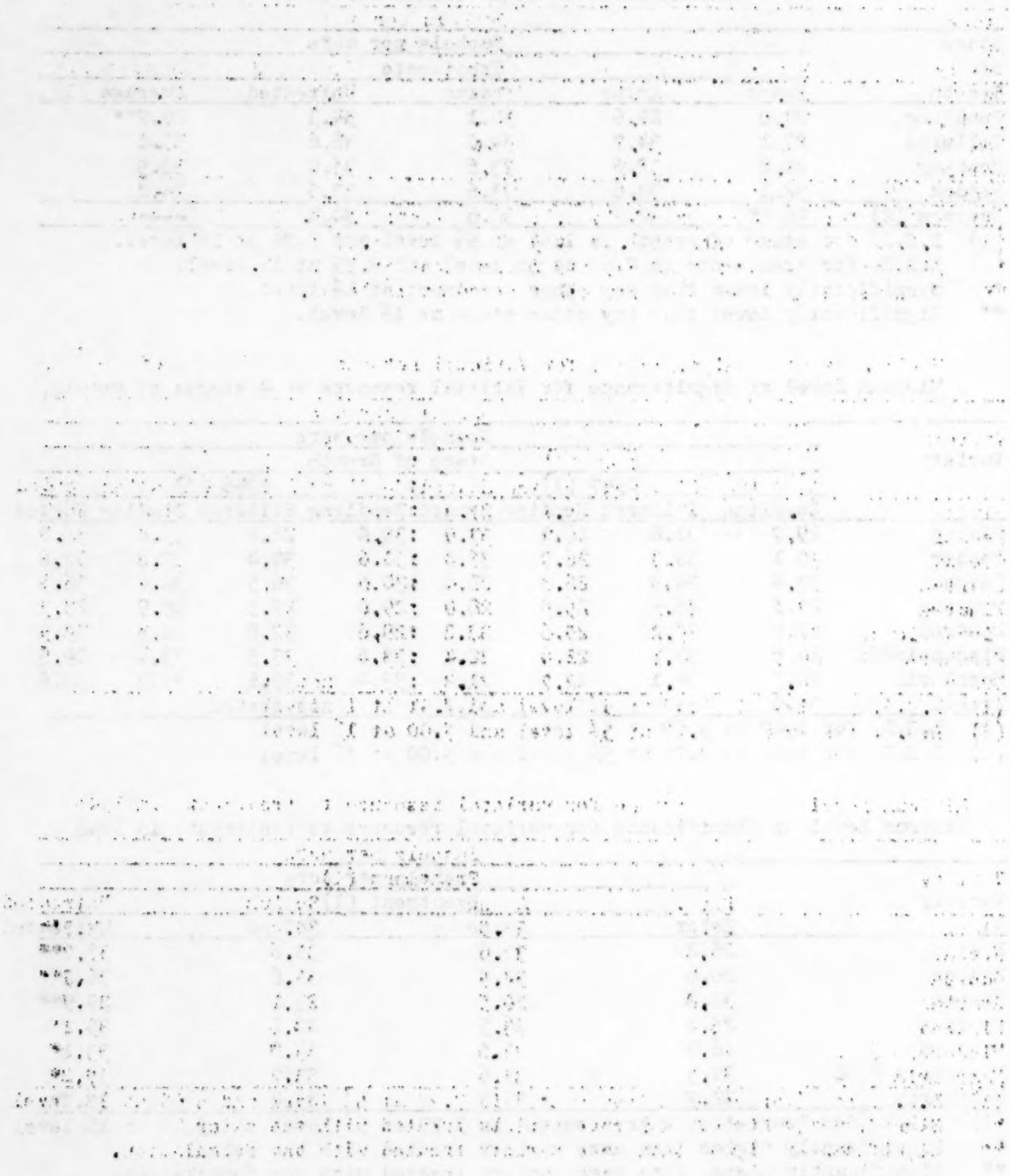
Variety	Bushels per acre — Stage of Growth							
	1947 (1)				1948 (2)			
	Seedling	Tillered	Heading	Headed	Seedling	Tillered	Heading	Headed
Plains	29.7	31.8	28.1	27.9	30.4	28.8	35.2	36.7
Feebar	30.1	39.3	36.7	33.8	31.2	34.4	27.8	32.8
Odessa	33.4	34.3	26.9	26.4	30.6	36.5	36.0	36.5
Spartan	25.6	26.6	26.8	28.4	24.0	27.5	26.9	25.1
Kindred	27.7	30.2	25.5	28.0	29.6	32.8	32.5	33.3
Wisconsin#38	24.6	39.2	29.6	32.2	28.6	33.5	33.8	34.5
Manchuria	24.7	34.1	22.4	22.4	33.4	39.1	35.4	33.6
Tregal	34.0	35.2	32.9	31.2	not tested			

(1) L.S.D. for 1947 is 5.99 at 5% level and 7.91 at 1% level
(2) L.S.D. for 1948 is 3.79 at 5% level and 5.00 at 1% level

Minimum Level of Significance for varietal response to treatments in 1948

Variety	Bushels per acre — Treatment (1)			
	Ester	Amine	Sodium	Untreated
Plains	26.2	33.5	33.8	37.7**
Feebar	26.8	32.0	31.6	36.2**
Odessa	31.8	34.5	33.6	39.9**
Spartan	25.8	26.5	27.1	24.2
Kindred	26.9	33.3	34.8	33.1*
Wisconsin # 38	27.3	33.6	33.7	35.8*
Manchuria	32.7	35.3	35.4	37.2*

(1) L.S.D. for "varieties x treatments" is 3.79 at 5% level and 5.00 at 1% level
* Significantly higher than same variety treated with the ester
** Significantly higher than same variety treated with any formulation.



20. Effect of 2,4-D as on herbicide on barley, Bohmont, Dale W. (Contributed by the University of Wyoming)

(Analysis Minus Check)

Variation Due to	DF	Sx^2	$\bar{x}$		F
Blocks	2	2,910.5	1,455.3		
Variety	1	68.76	68.76		
Treatment	23	2,479.40	107.8		1.04 (1)
Material	2	72.04	36.02		
Concentration	1	2.57	2.57		(2)
Stage	1	859.74	859.74		8.32 **
Material x Variety	2	174.49	87.25		
Material x Concentration	2	86.16	43.08		
Error	38	3,926.13	103.32	10.16	
Total	72	10,579.79			

(1) Significant difference for treatments for 5% point - 1.68
Significant difference for treatments for 1% point - 2.22
(2) Significant difference for stage for 1% point - 4.57

Average yield in bushels per acre.

Variety	Stage of Growth	Concentration	Ester	Amine	Salt	Average Yield
Lico Barley	Boot stage	1/2 lb.	36.6	36.6	37.7	37.0
		1 lb.	29.1	33.0	28.5	30.2
	Headed	1/2 lb.	41.4	40.9	35.9	39.4
		1 lb.	49.3	39.5	40.6	43.1
	No treatment					37.0
	Average for material		39.1	37.5	35.7	
Club Mariout	Boot stage	1/2 lb.	30.8	33.8	36.6	33.7
		1 lb.	31.8	27.3	34.0	31.0
	Headed	1/2 lb.	41.5	35.9	39.1	38.8
		1 lb.	37.0	50.7	27.3	38.3
	No treatment					42.0
	Average for Material		35.3	36.9	34.3	

21. Effect of various 2,4-D formulations sprayed at 3 different growth stages with 5 different rates on Thatcher Wheat. Leggett, H. W., (Contribution of Dominion Experimental Farms Field Husbandry Division, LaCombe, Alberta, Canada.)

Rate	Formulation	Stages (Average 3 Reps.) 1	2	3	Rate Average
0	Sodium Salt	47.8	39.2	39.9	42.3
1/8	"	40.0	36.0	34.4	36.8
1/4	"	33.9	37.1	24.5	31.8
1/2	"	34.6	34.3	27.6	32.2
3/4	"	33.5	33.2	22.8	29.8
1	"	34.7	32.7	19.2	28.9
AVERAGE		37.4	35.7	28.1	
0	Amine	44.5	39.9	35.2	39.9
1/8	"	42.2	41.1	31.6	38.3
1/4	"	39.0	36.0	26.9	34.0
1/2	"	39.5	34.7	23.4	32.5
3/4	"	36.6	31.7	24.7	31.0
1	"	31.9	30.9	17.9	26.9
AVERAGE		38.9	35.7	26.6	
0	Ester	37.5	40.8	31.4	36.6
1/8	"	36.7	39.9	26.2	34.3
1/4	"	36.0	39.2	25.8	33.7
1/2	"	36.3	34.0	24.3	31.5
3/4	"	34.5	33.3	22.3	30.0
1	"	33.8	30.9	17.4	23.7
AVERAGE		35.8	36.3	24.6	
STAGE AVERAGE		37.4	35.8	26.4	

M. S. D. for ^{xx}Stages 3.01 bushels.

M. S. D. for ^{xx}Rates 4.19 bushels.

22. Reaction of Mida Wheat Sprayed in Boot Stage with Three Formulations of 2,4-D. E. A. Helgeson, (Contributed by the North Dakota Agriculture Experiment Station.)

Chemical	Rate Applied 1 lb./A.	Yield bu./A.	Test Wt. lbs. per bushel	Average Wt. 500 kernels (gm.)
Sodium salt	1.0	15	62	19
	0.5	16	62	19
Alkanolamine	1.0	14	62	19
amine	0.5	18	62	20
Butyl ester	0.5	17	62	19
	1.0	15	62	19
Check	0	25	63	18

23. Reaction of Some Spring Wheats Sprayed with Three Formulations of 2,4-D at Tillering. E. A. Helgeson, (Contributed from North Dakota Agriculture Experiment Station.)

Variety and treatment		Yield bu. per acre	Test Wt. lbs. per bushel	Average Wt. 500 kernels (gm)	Average plant height (cm.)
Thatcher	0*	32.2	60	10.7	97
"	Na*	32.9	58	10.9	93
"	Am*	25.0	59	11.0	94
"	Est*	33.6	59	10.8	91
Mida	0	29.6	63	17.3	99
"	Na	29.1	63	17.8	99
"	Am	30.7	63	17.8	97
"	Est	28.5	63	18.1	94
Regent	0	27.6	61	13.7	96
"	Na	28.0	60	13.6	92
"	Am	30.8	61	13.7	92
"	Est	26.9	61	13.8	89
Rival	0	33.3	61	15.4	96
"	Na	30.2	61	15.4	93
"	Am	32.9	61	15.4	93
"	Est	30.8	61	15.5	90
Pilot	0	24.7	59	12.3	93
"	Na	26.9	59	12.6	94
"	Am	26.7	59	12.5	91
"	Est	26.9	60	13.9	91
Mindum	0	25.8	63	16.1	107
"	Na	23.7	63	15.8	104
"	Am	26.5	62	15.9	106
"	Est	24.0	62	15.9	106
Carleton	0	28.9	64	18.4	109
"	Na	28.4	64	18.4	107
"	Am	27.6	63	17.8	111
"	Est	29.7	63	17.6	107

*0 Check no treatment; Na sodium salt; Am. alkanolamine; Est. Butyl ester

24. Effect of 2,4-D as an herbicide on wheat, Bohmont, Dale W. (Contributed by the University of Wyoming)

(Analysis Minus Check)

Variation Due to	DF	Sx^2	$\bar{x}$	F
Blocks	2	1846.60	923.3	27.88**
Materials	2	330.77	165.38	4.99**
Concentration	1	91.52	91.52	2.76*
Stage	2	90.69	45.34	1.37
Varieties	1	1266.67	1266.67	38.26**
Material x Concentration	2	712.37	356.18	10.76**
Material x Stage	4	344.60	86.15	2.6*
Material x Variety	2	114.64	57.32	1.73
Concentration x Stage	2	177.07	88.53	2.67
Error	89	2946.83	33.11	5.75
Total	107	7921.76		

* Significant to the 5% point.
** Significant to the 1% point.

Variety	Stage of Growth	Concentration	Ester	Amine	Salt	Average yield
Thatcher	Late	1/2 lb.	34.5	35.1	31.7	33.8
	Tillering	1 lb.	32.5	30.7	28.6	30.6*
	Late Boot	1/2 lb.	37.1	37.7	33.4	36.0
		1 lb.	35.5	35.5	28.8	33.3
	Headed	1/2 lb.	32.8	40.3	36.8	36.6
		1 lb.	33.5	32.2	33.4	33.0
	Check	No treatment				36.1
	Average Yield for Material		34.3	35.3	32.1*	
Mida	Tiller	1/2 lb.	34.1	31.5	37.4	34.7
		1 lb.	35.0	28.8	37.5	33.8
	Early Boot	1/2 lb.	31.0	34.6	33.6	33.1*
		1 lb.	27.7	33.0	22.5	27.7**
	Headed	1/2 lb.	36.5	36.6	31.5	34.9
		1 lb.	33.1	33.4	35.7	34.1
	Check	no treatment				36.9
	Average Yield for Materials		32.9*	33.0*	33.2*	

Difference required for significance for concentrations and materials at the 5% point = 3.34 bu.; 1% point = 4.42 bu.

III.

25. Effect of 2,4-D as a selective herbicide on spring planted wheat. Foster, J. Roe. (Contributed by the Dominion Department of Agriculture, Experimental Farms Service, Dominion Experimental Sub-Station, Regina, Saskatchewan, Canada.)

Formulation	Ounces per acre	Bushels per acre				Percent of weed kill			
		3-leaf stages		5-leaf stages		3-leaf stages		5-leaf stages	
		dust	spray	dust	spray	dust	spray	dust	spray
Sodium salt	2	-	34.3	-	19.0	-	88	-	2
	3	26.2	-	-	-	22	-	-	-
	4	-	35.1	20.8	18.9	-	98	32	0
	6	27.2	-	-	-	37	-	-	-
	7	26.8	-	-	-	52	-	-	-
	8	-	33.0	22.7	21.4	-	99	47	4
	13	-	-	21.9	-	-	-	93	-
	Check	25.8	28.1	21.4	20.4	-	-	-	-
Amine	2	-	29.5	-	25.5	-	95	-	7
	3	26.5	-	26.6	-	7	-	22	-
	4	-	30.4	-	25.9	-	97	-	60
	5	26.2	-	-	-	7	-	-	-
	6	-	-	26.0	-	-	-	76	-
	8	28.6	30.3	-	24.1	75	100	-	90
	10	-	-	26.7	-	-	-	98	-
	Check	25.3	24.6	26.1	24.4	-	-	-	-
Ester	2	32.3	32.5	-	27.6	94	100	-	92
	3	32.7	-	25.7	-	99	-	25	-
	3	-	-	26.0	-	-	-	99	-
	4	-	33.8	-	26.9	-	99	-	99
	5	32.4	-	-	-	100	-	-	-
	8	-	33.0	-	26.3	-	99	-	100
	10	-	-	26.1	-	-	-	99	-
	Check	27.6	27.2	27.4	27.2	-	-	-	-

26. Controlling annual weeds in wheat and flax with 2,4-D and allied chemicals. Wood, H. E. and J. J. Boruns. (Contributed by the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada.)

Flax	Sanford	Hampson
2 oz. Sodium Salt	268 gms.	Check 104 gms.
8 oz. Sodium Salt	235 gms.	
1½ oz. Amine	240 gms.	Check 207 gms.
6 oz. Amine	200 gms.	
1 oz. Ester	200 gms.	Check 193 gms.
4 oz. Ester	198 gms.	

Wheat	Oakbank	Dunn
May 28 - 4 oz. Ester	918 gms.	Check 990
6 oz. Amine	918 gms.	
June 9 - 4 oz. Ester	708	Check 525
6 oz. Amine	528	

Chemical Summerfallow

Summerfallow -	Check	528 gms.
Summerfallow -	Treated	335 gms.

27. Effect of various systemic (hormone) herbicides on spring wheat and common weeds treated at the early boot stage on sandy loam. Saskatoon, Sask. 1948 Pavlychenko, Thomas K. (Contributed by Agr. Field Res., American Chemical Paint Co., Ambler. Pa.)

CHEMICAL (2) CROP

Name	Rate oz/A.	Stunting	Yield bu/A	C.W.M.(1)% Stunt.	C.W.M.(1)% Kill	C.W.M.(1)% Seed	Stinkweed (1)% Stunt.	Stinkweed (1)% Kill.	Stinkweed (1)% Seed	Russian Thistle (1)% Stunt.	Russian Thistle (1)% Kill.	Russian Thistle (1)% Seed	Wild Buckwheat(1)% Stunt.	Wild Buckwheat(1)% Kill.	Wild Buckwheat(1)% Seed
Control	0	0	4.3	0	0	100	0	0	100	0	0	100	0	0	100
Wc. 48	2	0	5.2	-	100	-	strong	76	20	mild	0	35	slight	0	85
	4	0	5.7	-	100	-	severe	85	5	strong	0	20	slight	0	60
	8	slight	6.1	-	100	-	severe	98	0	severe	20	10	mild	0	50
LFN549	2	0	4.8	-	100	-	strong	80	8	mild	0	25	slight	0	90
	4	0	5.9	-	100	-	severe	92	0	strong	0	15	slight	0	85
	8	mild	5.1	-	100	-	-	100	-	severe	25	10	mild	0	55
W#5	2	0	5.4	-	100	-	strong	78	18	mild	0	30	slight	0	80
	4	0	6.9	-	100	-	severe	90	0	strong	0	20	mild	0	45
	8	slight	6.3	-	100	-	severe	97	0	severe	25	10	strong	0	35
Wr64	2	0	5.3	-	100	-	strong	74	20	mild	0	30	slight	0	86
	4	0	7.1	-	100	-	severe	84	0	strong	0	15	slight	0	75
	8	0	7.2	-	100	-	severe	98	0	severe	15	15	mild	0	45
LFN472	2	0	4.6	strong	76	10	mild	64	25	slight	0	30	0	0	0
	4	0	6.8	severe	94	2	strong	70	15	mild	0	15	slight	0	85
	8	0	7.4	-	100	-	severe	94	4	strong	0	10	mild	0	55
95%MSS	2	0	4.5	strong	80	8	mild	65	20	mild	0	20	slight	0	85
	4	0	5.4	severe	96	2	strong	75	10	strong	0	10	mild	0	60
	8	0	6.3	-	100	-	severe	98	2	strong	0	5	mild	0	50
W.N.M.	2	0	5.8	-	100	-	strong	86	12	mild	0	25	slight	0	80
	4	slight	7.2	-	100	-	severe	91	6	strong	0	8	mild	0	50
	8	mild	5.9	-	100	-	-	100	-	severe	35	3	strong	0	30

(1) C.W.M. = Common Wild Mustard (Sinapis arvensis); Stinkweed = Thlaspi arvense; Russian Thisle = Salsola kali; W. Buckwheat = Wild buckwheat (Polygonum convolvulus)

(2) Wc.48 = Weedone concentrate 48, commercial ethyl ester; LFN549 = ester of 2,4,5-T; W#5 = Weedone #5, x ethyl ester; Wr. 64 = Weedar 64, amine salt; LFN472 = 2,4-D acid; 95% MSS = 95% monohydrate sodium salt; W.N.M. = Weed-no-More, butyl ester.

27. Effect of various systemic (hormone) herbicides on spring wheat and common weeds treated at the early tillering stage (21 days after emergence) on sandy loam. Saskatoon, Sask. 1948. Pavlychenko, Thomsas, K. (Contributed by Agric. Field Res. American Chemical Paint Co., Ambler, Pa.)

CHEMICALS (2)		CROP													
Name	Rate oz/A.	Stunting	Yield bu/A	C.W.M.(1)% Stunt.	Kill	Seed	Stinkweed (1)% Stunt.	Kill.	Seed	Russian Thistle(1)% Stunt.	Kill	Seed	Wild Buckwheat (1)% Stunt.	Kill	Seed
Control	0	0	7.4	-	0	100	-	0	100	-	0	100	0	0	100
Wc. 48	2	0	8.2	-	100	-	-	100	-	strong	0	20	slight	0	70
	4	0	9.3	-	100	-	-	100	-	strong	0	10	mild	0	45
	8	slight	9.0	-	100	-	-	100	-	severe	30	0	strong	0	15
LFN549	2	slight	9.2	-	100	-	-	100	-	strong	0	10	mild	0	55
	4	slight	9.7	-	100	-	-	100	-	strong	0	5	strong	0	35
	8	mild	8.6	-	100	-	-	100	-	severe	40	0	strong	5	10
W#5	2	0	8.4	-	100	-	-	100	-	strong	0	15	mild	0	50
	4	0	9.3	-	100	-	-	100	-	strong	10	10	mild	0	30
	8	slight	9.6	-	100	-	-	100	-	severe	30	0	strong	0	20
Wr.64	2	0	8.7	-	100	-	-	100	-	strong	0	20	slight	0	65
	4	0	9.5	-	100	-	-	100	-	severe	20	0	slight	0	60
	8	0	10.3	-	100	-	-	100	-	severe	45	0	strong	0	25
LFN472	2	0	7.8	strong	82	-	strong	76	4	mild	0	40	slight	0	80
	4	0	9.8	severe	94	-	severe	88	0	strong	0	25	mild	0	65
	8	0	10.1	-	100	-	severe	97	0	strong	0	15	mild	0	50
95%MSS	2	0	7.2	strong	85	-	strong	81	2	mild	0	30	slight	0	65
	4	0	8.9	severe	96	6	severe	92	0	strong	0	20	mild	0	50
	8	0	9.8	-	100	-	-	100	-	strong	0	10	mild	0	45
W.N.M.	2	0	8.0	-	100	-	-	100	-	strong	0	10	mild	0	65
	4	0	9.6	-	100	-	-	100	-	strong	15	0	mild	0	45
	8	0	7.9	-	100	-	-	100	-	severe	45	-	strong	3	15

(1) C.W.M. = Common Wild Mustard (Sinapis arvensis); Stinkweed = Thlaspi arvense; Russian thistle = Salsola kali; W. buckwheat = Wild buckwheat (Polygonum convolvulus).

(2) Wc.48 = Weedone concentrate 48, commercial ethyl ester; LFN472 = 2,4-D acid; 95%MSS = 95% monohydrate sodium salt; W.N.M. = Weed-No-More, butyl ester; Wc. 48a/f = Weedone concentrate 48 without free acid.

28. Effect of various systemoi (hormone) herbicides on spring wheat and common weeds treated at the late-boot stage on Saskatoon chocolate Loam. Floral, Sask. 1948 Pavlychenko, Thomas K. (Contributed by Agric. Field Res., American Chemical Paint Co. Ambler, Pa.)

CHEMICAL (2)		CROP														
Name	Rate oz/A	Stunting	Yield bu/A.	C.M.M.(1)% Stunt.	Kill	Seed	Stinkweed (1)% Stunt.	Kill	Seed	Russian Thistle(1)% Stunt.	Kill	Seed	Wild Buckwheat (1)% Stunt.	Kill	Seed
Control	0	0	13.8	-	0	100	0	0	100	0	0	100	0	0	100
Wc. 48	2	0	21.8	-	100	-	severe	92	4	strong	0	15	mild	0	20
	4	slight	18.0	-	100	-	severe	98	0	severe	10	0	strong	0	10
LFN549	2	slight	19.1	-	100	-	-	100	-	strong	5	10	strong	0	35
	4	mild	20.8	-	100	-	-	100	-	severe	25	0	severe	0	10
W#5	2	0	20.9	-	100	-	severe	98	0	strong	0	10	mild	0	60
	4	0	21.8	-	100	-	-	100	-	severe	15	0	strong	0	40
Wr.64	2	0	21.8	-	100	-	severe	97	0	strong	0	10	mild	0	60
	4	0	21.8	-	100	-	severe	99	0	severe	0	0	strong	0	40
LFN472	2	0	18.5	strong	80	4	strong	80	6	mild	0	30	slight	0	80
	4	0	22.6	severe	96	0	severe	90	3	strong	0	20	mild	0	60
95%MSS	2	0	21.0	strong	90	2	strong	86	5	mild	0	25	slight	0	75
	4	0	20.9	severe	98	1	severe	93	2	strong	0	20	mild	0	50
W.N.M.	2	0	21.4	-	100	-	-	100	-	strong	0	10	mild	0	50
	4	mild	15.8	-	100	-	-	100	-	severe	5	0	severe	0	15
Wc.48a/f	2	0	19.1	-	100	-	severe	98	0	strong	0	10	mild	0	65
	4	0	21.8	-	100	-	-	100	-	severe	5	0	strong	0	30

(1) C. W. M. = Common Wild Mustard (Sinapis Arvensis); Stinkweed = Thlaspi arvense; Russian Thistle = Salsola kali; W. buckwheat = Wild buckwheat (Polygonum convolvulus).

(2) Wc48 = Weedone concentrate 48, commercial ethyl ester; LFN549 = ester of 2,4,5-T; W#5 = Weedone #5, ethyl ester; Wr.64 = Weedar 64, amine salt; LFN472 = 2,4-D acid; 95%MSS = 95% monohydrate sodium salt; W.N.M. = Weed-No-More, butyl ester; Wc.48a/f = Weedone concentrate 48 without free acid.

32. The effect of 2,4-D on wheat oats and barley, Olson, P. J. and Saul Zalik (Contribution by the Division of Plant Science, University of Manitoba, Winnipeg Manitoba, Canada)

Treatment	1st Stage of Growth	Wheat				Oats			Barley		
		Redman	Thatcher	Stewart	All Vars.	Ajax	Exeter	Both Vars.	Montcalm	Vantage	Both Vars.
Amine	4 oz.	52.9	47.7	76.0	58.9	118.2	123.5	120.8	79.0	92.2	85.6
"	8 oz.	56.4	47.5	72.3	58.7	117.7	134.3	126.0	74.6	108.9	91.8
"	16 oz.	51.4	48.4	68.0	55.9	112.8	138.3	125.6	74.2	103.3	88.8
Ester	4 oz	53.6	49.9	67.2	56.9	117.9	145.9	131.9	70.1	99.9	85.0
"	8 oz.	52.2	45.6	65.9	54.6	117.1	126.4	121.8	82.5	91.2	86.8
"	16 oz.	50.7	42.1	68.2	53.7	110.1	116.7	113.4	60.1	73.9	67.0
Sodium	4 oz.	56.9	46.2	69.6	57.6	121.8	128.0	124.9	67.8	97.8	82.8
"	8 oz.	53.9	42.9	71.7	56.2	131.4	132.3	131.8	76.6	99.0	87.8
"	16 oz.	52.8	48.7	74.5	58.7	116.5	137.6	127.0	80.0	100.3	90.2
Stage of growth at 2nd date of treatment		10 days after heading		2 days before heading		5 days after heading	3 days after heading		5 days after heading		
Amine	4 oz.	54.7	38.4	65.7	52.9	129.1	136.5	132.8	80.7	94.8	87.8
"	8 oz.	53.0	39.2	66.6	52.9	116.4	139.8	128.1	77.1	99.8	88.4
"	16 oz.	50.8	43.8	64.8	54.8	120.3	132.4	126.4	80.3	99.6	90.0
Ester	4 oz.	51.8	42.9	63.0	52.6	108.9	121.0	115.0	77.6	94.9	86.2
"	8 oz.	53.7	48.5	63.8	55.3	109.4	129.1	119.2	72.6	83.8	78.2
"	16 oz.	46.6	38.5	57.8	47.6	111.5	131.2	121.4	57.6	67.6	62.6
Sodium	4 oz.	51.2	46.6	64.5	54.1	133.4	134.4	133.9	72.7	97.2	85.0
"	8 oz.	54.1	50.9	66.9	57.3	122.3	119.9	120.6	79.4	98.8	89.1
"	16.oz.	55.4	45.0	64.8	55.1	126.4	144.4	135.4	77.8	98.0	87.9
Mean of check		56.3	46.9	68.2	57.1	117.6	134.3	126.0	66.7	94.2	80.4
Minimum significant difference for 2 treatments		6.9	6.9	6.9	4.0	Differences not statistically significant for oats or barley					
Minimum significant for any treatment and means of checks		5.3		5.3	5.3	3.0					

Mean Yields of Montcalm Treated with 12 oz. butyl ester per acre

Date of Application	Stage of Growth	Bu. per acre	Date of Application	Stage of growth	Bu. per acre
May 13	3 days after seed	93.0	June 14	9 in.	92.4
18	½ in.	106.9	17	10 in.	101.9
21	1 in.	74.2	22	4 da. before head.	43.6
24	1½ in.	100.1	25	1 da. before head.	65.8
27	2 in.	60.1	28	2 da. after head.	66.1
29	2½ in.	91.7	July 1	5 da. after head.	87.6
June 1	3½ in.	112.4	5	9 da. after head.	96.5
4	5 in.	111.1	8	12 da. after head.	111.9
8	7 in.	97.6	11	15 da. after head.	89.0
11	8 in.	99.4	14	18 da. after head.	109.0

Mean of checks is 101.7

Necessary difference at 5% point is 27.3 bu. per acre.
significant decrease in yield from mean of checks.

33. Effect of 2,4-D as a selection herbicide in wheat and barley.
Sexsmith, J. J. (Contribution of the Dominion Department Agricultural Experiment Station, Lethbridge, Alberta, Canada.)

Average Yields (in bushels) for Six Varieties of Wheat and Six Varieties of Barley

Treatment	Wheat	Barley +
Check	31.3	64.3
Ester 2 oz.	32.1	64.6*
Ester 4 oz.	31.6	58.5
Ester 8 oz.	29.7	50.5*
Ester 12 oz.	26.7*	49.4*
Amine 4 oz.	33.5	59.9
Amine 8 oz.	31.3	63.0
Amine 12 oz.	30.7	58.6*
Minimum Significant Difference (5% pt.)	2.8	5.0

+ Two replicates only for barley, Rep. 1 discarded

Variance Table

Variation due to	Wheat			Barley		
	DF	Mean Square	F. Value	DF	Mean Square	F.Value
Varieties	5	141.8760	7.945**	5	637.0840	16.768**
Treatments	7	71.3729	3.997**	7	409.5286	10.779**
Replicates	2	165.9100	9.290**	1	22.4300	.590
Var.xTreat.	35	8.2406	.461	35	39.8914	1.050
Error	94	17.8585		47	37.9934	
Total	143			95		

** Significant at 1% level

Average Yield (in bushels) of MARQUIS wheat

Check	31.6
Ester 2 oz	31.2
Ester 4 oz.	29.7
Ester 8 oz.	25.6*
Ester 12 oz.	20.5*
Amine 4 oz.	32.0
Amine 8 oz.	30.2
Amine 12 oz.	27.9
Minimum Significant Difference (5% pt.)	5.8

Variance Table

Variation due to	Df	Mean Square	F. Value
Treatments	7	45.543	3.56*
Replicates	2	39.140	3.06
Error	14	12.784	
Total	23		

* Significant at 5% level

Average Weight (in grams of Grain from 25 Heads for Six Varieties of Barley

Check	40.22
Ester 2 oz.	37.45*
Ester 4 oz.	37.68*
Ester 8 oz.	35.13*
Ester 12 oz.	33.25*
Amine 4 oz.	39.08
Amine 8 oz.	37.93*
Amine 12 oz.	37.48*
Minimum Significant Difference (5% pt.)	1.98

Variance Table

Variation due to	Df	Mean Square	F. Value
Varieties	5	1,507.6879	170.166**
Treatments	7	85,7821	9.682**
Replicates	2	43.4211	4.901**
Var. x Treat.	35	16.2698	1.836*
Error	94	8.8601	
Total	143		

** Significant at 1% level
* Significant at 5% level

Average Weight (in grams) of Grain from 25 Heads of TREBI Barley

Check	52.04
Ester 2 oz.	50.14
Ester 4 oz.	45.64*
Ester 8 oz.	41.92*
Ester 12 oz.	35.49*
Amine 4 oz.	53.40
Amine 8 oz.	51.34
Amine 12 oz.	49.15
Minimum Significant Difference (5% pt.)	5.35

Variance Table

Variation due to	Df	Mean Square	F. Value
Treatments	7	110.8160	10.310**
Replicates	2	35.7381	3.325
Error	14	10.7481	
Total	23		

** Significant at 1% level.

Effect of various systemic herbicides on flax from emergence to 21 day stage.
Pavlychenko, Thomas K. Ab. 45 III

State of Growth			Rates	Characters Studied						
Days after em.	Ht. in.	Chemical formulation[1]	oz/a. acid eq.	Curling %	Stunting inch	Discoloration	Recovery %	Delay days	Killed %	Ht. in.
2	1	A	2	100	3	strong	slow	8	60	19
2	1	B	2	100	-	severe	—	-	100	--
2	1	C	2	100	3	strong	slow	10	65	19
2	1	D	2	100	3	mild	slow	4	20	19
2	1	E	2	slight	0	0	100	0	0	22
2	1	F	2	slight	0	0	100	0	0	22
2	1	G	2	100	8	strong	v.slow	12	95	14
2	1	Control[2]	0	0	0	0	0	0	0	22
2	1	A	4	100	6	strong	poor	14	85	14
2	1	B	4	100	-	--	0	—	100	--
2	1	C	4	100	7	strong	slow	15	87	15
2	1	D	4	100	7	strong	poor	12	55	15
2	1	E	4	slight	0	0	rapid	0	0	22
2	1	F	4	slight	0	slight	rapid	0	0	22
2	1	G	4	100	12	severe	poor	14	96	10
2	1	Control[2]	0	0	0	0	0	0	0	22
6	2	A	2	100	3	strong	fair	6	45	19
6	2	C	2	100	3	strong	fair	5	35	19
6	2	D	2	100	2	mild	good	4	25	20
6	2	E	2	slight	0	0	100	0	0	22
6	2	F	2	slight	1	slight	100	2	0	21
6	2	G	2	100	5	severe	poor	10	55	17
6	2	Control[2]	0	0	0	0	0	0	0	22
6	2	A	4	100	6	severe	v.poor	10	60	16
6	2	C	4	100	5	strong	v.poor	10	52	17
6	2	D	4	100	4	strong	poor	6	38	18
6	2	E	4	0	0	0	100	0	0	22
6	2	F	4	slight	1	slight	100	2	3	21
6	2	G	4	100	6	severe	v.poor	12	65	16
6	2	Control[2]	0	0	0	0	0	0	0	22
9	3	A	2	100	2	mild	fair	6	15	20
9	3	B	2	100	3	strong	poor	8	35	19
9	3	C	2	100	1	mild	good	4	10	21
9	3	D	2	100	1	mild	good	3	4	21
9	3	E	2	slight	0	0	100	0	0	22
9	3	F	2	slight	1	0	excell.	1	0	21
9	3	G	2	100	5	strong	v.poor	10	30	17
9	3	Thiourea	2	slight	0	0	100	0	0	22
9	3	Control[2]	0	0	0	0	0	0	0	22
9	3	A	4	100	10	severe	v.poor	10	65	12
9	3	B	4	100	12	severe	v.poor	12	75	10
9	3	C	4	100	6	strong	good	4	15	16
9	3	D	4	100	5	mild	good	4	10	17
9	3	E	4	slight	0	0	100	0	0	22
9	3	F	4	slight	1	slight	100	0	0	21
9	3	G	4	100	5	strong	poor	14	70	17
9	3	Thiourea	4	0	2	0	100	3	0	20
9	3	Control[2]	0	0	0	0	0	0	0	22

Note: In the above trials Russian thistle was permanently stunted by LEN549, WNM, Wc.48, W#5, W-r64, 95% M.S.S., and LEN472 in this decreasing order of their placing and rates. Only LEN549, WNM, W.c.48, W#5, and W-r64 actually killed from 30 to 15% of this weed.

Effect of various systemic herbicides on flax from emergence to 21 day stage. Pavlychenko, Thomas K. (continued).

Ab. 45 (Cont.)

State of Growth			Rates	Characters Studied						
Days after em.	Ht. in.	Chemical formulation 1/	oz/a. acid eq.	Curling %	Stunting inch	Discoloration	Recovery %	Delay days	Killed %	Ht. in.
12	3 1/2	A	2	100	1	mild	good	4	2	21
12	3 1/2	C	2	100	0	slight	excell.	2	0	22
12	3 1/2	D	2	100	0	slight	excell.	2	0	22
12	3 1/2	E	2	0	0	0	100	0	0	22
12	3 1/2	F	2	slight	0	slight	100	1	0	22
12	3 1/2	G	2	100	1	slight	good	4	4	21
12	3 1/2	Control 2/	0	0	0	0	0	0	0	22
12	3 1/2	A	4	100	2	mild	good	4	8	20
12	3 1/2	C	4	100	1	slight	100	2	0	21
12	3 1/2	D	4	100	1	slight	100	2	0	21
12	3 1/2	E	4	0	0	0	100	0	0	22
12	3 1/2	F	4	slight	0	slight	100	0	0	22
12	3 1/2	G	4	100	3	mild	good	6	10	19
12	3 1/2	Control 2/	0	0	0	0	0	0	0	22

Note: In all of the above trials Redwing flax was also included; it was slightly more resistant to all the chemicals, but was slow to recover when injured.

State of Growth			Rates	Characters Studied							
Days after em.	Ht. in.	Chemical formulation 1/	oz/a acid eq.	Curling %	Stunting inch	Discoloration	Recovery %	Delay days	Sterility %	Ht. in mat.	Yield bu. per acre
21	6	A	2	100	2	slight	100	3	0	16	6.2
21	6	B	2	100	3	strong	good	4	0	15	4.7
21	6	C	2	100	1	slight	good	3	0	17	6.9
21	6	D	2	100	1	slight	100	2	0	17	7.1
21	6	E	2	slight	0	0	100	0	0	18	7.9
21	6	F	2	slight	0	slight	100	1	0	18	7.7
21	6	G	2	100	4	strong	fair	9	0	14	4.1
21	6	Control 2/	0	0	0	0	0	0	0	16	3.8
21	6	A	4	100	2	mild	good	4	0	16	5.3
21	6	B	4	100	5	severe	fair	12	30% kill	13	2.9
21	6	C	4	100	3	mild	good	4	0	15	4.8
21	6	D	4	100	2	mild	good	3	0	16	6.3
21	6	E	4	slight	1	slight	100	1	0	17	7.6
21	6	F	4	slight	1	mild	100	2	0	17	7.9
21	6	G	4	100	4	strong	fair	10	0	14	3.9
21	6	Control 2/	0	0	0	0	0	0	0	18	3.6

1/ A = Weedone cone 48, B = 2,4,5-Tester, C = Weedone #5, D = Weedar 64, E = 2,4-D acid, F = Monohydrate sodium salt, G = Weed-No-More.

2/ Averages of 8 plots.

Effect of 2,4-D on severity of flax rust. Sackston, W. E. Ab. 46

2,4-D rate lbs. acid per acre	Sodium Salt Stage of flax when sprayed			Amine Stage of flax when sprayed			Ester Stage of flax when sprayed		
	3"-4"	6"-8"	Prebloom	3"-4"	6"-8"	Prebloom	3"-4"	6"-8"	Prebloom
Unsprayed check	L*	L	L	L-M	L	L	L-M	L	L
1/8	L	L	L-M	L-M	L	M	M	L	L+
1/4	L	L-M	M	L-M	L	M	L-M	L	L-M
1/2	L	L-M	M	L-M	L	Missing	L-M	L	M-H
3/4	L	L-M	M	L-M	L	M+	M	L-M	H
1 lb.	L	L-M	M+	L-M	M-H	M+	M	M	H+

*L = light infection, M = moderate infection, H = heavy infection

Ab. 47

Effect of herbicidal oils, oils fortified with PCP and sodium PCP in water spray on weeds in flax & on yields & test weight of flax seed. Brookings, S.D. Stahler, L. M. and Lyle A. Derscheid.

Chemical used	Gal. per acre	Maturity at time of normal full bloom[1]	Yield bu.per acre	Test wt. lbs. per bushel	% survival of weeds G[2]	% survival of weeds B[3]
Shell Oil ACX 184[4]	40	A-	18.1	53.3	75	100
Shell Oil ACX 184	80	B+	19.7	53.7	25	100
Shell ACX 170	40	B+	14.0	52.7	25	95
Shell ACX 170	80	B-	12.1	52.5	7	100
Shell ACX 238	40	C	7.5	---	45	10
Shell ACX 237	40	C-	8.9	---	7	-1
Shell ACX 224	40	C	18.1	53.3	10	60
Shell ACX 224	80	C-	16.4	53.7	8	30
PCP in water 4#	40	B	19.0	54.2	80	20
PCP in water 8#	40	C+	17.7	54.1	80	5
Untreated checks	--	A	18.8	54.5	100	100

1/ A = full bloom (normal); B = full bud; C = pre-bud.
2/ G = grass weeds, Setaria spp., Echinochloa spp., Panicum spp. & Avena fatua.
3/ B = broad leaved weeds, Amaranthus spp., Polygonum spp., Ambrosia spp.
4/ Shell ACX - experimental herbicidal oils supplied by Shell Oil Labor Laboratories, New York, N.Y. ACX 238, & ACX 237 contain 1.25% & 2.5% respectively PCD.

Ab. 48

Effect of 2,4-D as a selective herbicide in flax. Taylor, D. K.

Treatment	Growth period	Stage of Application: 4 inches Pl. ht.	4 inches Yield total	4 inches Yield straw	4 inches Yield seed	8 inches Pl. ht.	8 inches Yield total	8 inches Yield straw	8 inches Yield seed
	days	in.	lb.	lb.	bu.	in.	lb.	lb.	bu.
Sodium salt 1/4	83	34.7	4683	3765	5.7	34.3	4565	3627	6.1
1/2	83	32.7	4533	3531	6.7	32.7	4331	3317	6.9
3/4	86	32.7	4064	3147	5.7	30.0	3403	2581	5.5
1	86	30.7	3147	2368	5.7	27.3	3179	2347	5.5
Amine 1/4	83	34.3	4725	3808	5.5	31.0	4107	3424	5.2
1/2	84	32.0	3765	2933	4.9	30.3	3360	2635	5.1
3/4	87	31.3	3179	2475	4.6	25.7	2496	1909	3.7
1	90	27.3	2261	1728	3.6	25.3	2400	1523	3.9
Ester 1/4	83	34.3	3947	3200	4.5	33.7	3904	3125	5.0
1/2	86	35.0	3840	3008	4.9	31.3	2837	2379	4.7
3/4	89	30.0	2592	2059	3.1	28.7	2325	1749	3.6
1	92	27.7	2368	1803	3.4	24.3	1867	1365	3.2
Check	78	37.7	5035	4203	5.1	39.3	4757	3840	5.9
S.E.m.d.			306.2	171.6	.808		433.3	337.6	.704
M.S.D. (.05)			645.0	482.7	1.7		892.5	702.1	1.5
(.01)			876.0	656.1	2.3		1213.2	945.2	2.0

PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS

Tabular Data

Investigation III-6. Use of 2,4-D as a Selective Herbicide in Controlling Weeds in Legumes Seeded With Wheat, Oats or Barley

Ab. 1
Response of red clover and alfalfa seedlings to three preparations of 2,4-D applied at several rates. Buchholtz, K. P. (Dept. Agronomy, Univ. of Wis., Madison, Wisconsin).

2,4-D preparation	Application Lbs./acre	% check stand	
		Red clover	Alfalfa
Sodium salt	0.25	100	100
	0.5	109	89
	1.0	98	68*
	2.0	100	46**
Amine	0.25	100	94
	0.5	100	73*
	1.0	100	73*
	2.0	60**	42*
Butyl ester	0.125	115	95
	0.25	117	95
	0.5	93	37**
	1.0	44**	11**
	2.0	6**	0**
L.S.D. - 5% level		29	27
1% level		38	36
Check - plants/sq. ft.		8.4	8.8

PROJECT III EFFECT OF 2,4-D AS A SELECTIVE HERBICIDE IN GROWING CROPS

Tables of Results of Individual Cooperators.

Fall Planted Wheat, Oats, or Barley

Ab.50 Effect of 2,4-D on winter barley at Columbus, Ohio. Shaw, Warren C. and Willard, C. J.

Ohio No. 1 winter barley. Randomized block design, 3 replications of each treatment. Yields estimated by taking 3 samples of 1 square yard each from each plot. Plots 10' x 70'. Weeds were not a factor in the yields.

Rate of treatment per acre, acid equivalent	Yield per acre, after treating on: March 30, 6 inches tall		April 17, 10 inches tall		May 5, 2-joint stage		May 20, In full bloom	
	Amine salt	Butyl ester	Amine salt	Butyl ester	Amine salt	Butyl ester	Amine salt	Butyl ester
Lb.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
0	60.8	60.8	64.2	64.2	74.8	74.8	63.9	63.9
1/4	69.4	66.8	63.6	61.5	65.9	59.5	64.6	68.5
1/2	63.8	59.9	67.8	68.8	70.9	68.1	62.5	58.3
3/4	63.1	66.1	55.2	64.0	59.4	60.0	64.1	65.1
1	60.6	55.8	63.8	62.8	63.0	64.5	56.2	62.4
Av. all treated plots	64.2	62.2	62.6	64.3	64.8	63.0	61.8	63.6

Av. all checks, 65.9 bu.

Ab.51 Effect of 2,4-D as a selective herbicide on Pawnee winter wheat. Woestemeyer, V. W.

Effect of 2,4-D on Yield of Wheat in Bushels per acre

Stage	Type	Rate of application of 2,4-D, pounds per acre: 0	1/8	1/4	1/2	3/4	1	2	3	Av. of ½ - 1 lb.
I	Na Salt	11.1	11.9	10.8	10.4	11.3	13.6			11.8
Full	Amine		12.6	13.2	12.1	12.8	13.2			12.7
Tiller	Ester		11.9	14.6	12.1	12.9	11.6			12.2
										Av.12.2
II	Na Salt	11.7			9.7	9.4	13.5	12.4	10.6	10.9
Late	Amine				10.2	12.0	10.2	6.6	4.9	10.8
Boot	Ester				10.8	8.0	10.1	5.1	4.1	9.6
										Av.10.4
III	Na Salt	11.4	9.5	10.9	10.8	12.8	13.4			12.3
Post	Amine		12.7	11.0	10.7	12.5	11.8			11.7
Bloom	Ester		10.7	10.0	11.6	11.8	10.4			11.3
										Av.11.8

Ab.82 A comparason of effect of various treatments on seedling warm season grasses. Viehmeyer, Glenn, McDermand, John.

Forage yield of five warm season grasses receiving various cultural treatments. (Average yield in grams per 8' row 3 replications)

Treatment	Switch	Sand love	Sideoats gramma	Blue gramma	Indian
Hand weeded	424.9	949.2	389.6	524.7	234.3
Mowed	32.9	147.8	32.4	34.0	16.1
1/2 lb ester	37.8	126.1	41.5	45.7	15.2
1/4 lb. ester	35.9	163.4	48.7	49.3	20.2
1/8 lb ester	25.4	106.1	41.7	56.2	11.2
2.0 lbs. sodium	42.5	154.0	38.1	63.9	25.3
1.0 lb. sodium	54.1	248.8	51.0	75.4	14.8
1/2 lb. sodium	44.6	101.5	42.4	50.6	13.6
1/4 lb. sodium.	26.4	160.9	34.8	85.5	17.6

(Contribution North Platte Substation, Uni of Nebr and Soil Conservation Service)

Ab.52 Effect of fall treatments of 2,4-D on Pawnee wheat. Elder, W. C.

Treated 30 days after planting
Randomized Block Design
Yields in Bushels per acre (Average 4 Replications)

Rates of Treatment Lbs. per acre	Na Salt	Butyl Ester	Average
0	16.7	16.7	16.7
1/2	19.6	18.5	19.1
1	20.4	19.0	19.7
2	19.7	15.9	17.8
Average of Treated Plots	19.9	17.8	

Ab.53 Effect of 2,4-D on Pawnee winter wheat. Elder, W. C.

Randomized Block Design
Yields in Bushels per acre (Average 4 Replications)

Rate of Treatment	Full Tiller Stage			Early Joint Stage			Boot Stage			
Lbs. per acre	Na Salt	Amine	Ester	Na Salt	Amine	Ester	Na Salt	Amine	Ester	Av.
0	10.1	10.1	10.1	12.0	12.0	12.0	11.5	11.5	11.5	11.2
1/4	10.1	11.0	11.2	11.0	10.3	13.0	11.2	11.0	12.0	11.2
1/2	11.5	10.5	9.2	10.2	10.5	11.4	12.4	10.5	11.0	10.8
1	11.0	11.0	11.1	11.1	11.4	11.2	11.1	11.2	11.0	11.1
Average Treated Plots	10.9	10.8	10.5	10.8	10.7	11.9	11.6	10.9	11.3	

Ab.54 2,4-D as a selective herbicide in winter wheat. Phillips, W. M.

Yields and germination from an experiment using 2,4-D as a selective herbicide in winter wheat at the Fort Hays Experiment Station, Hays, Kansas.

		Stages of Wheat Growth							
		Pre-fully Tillered		2nd Joint		3/4 Headed		10 days Before Harvest	
Type of 2,4-D	Rate: lbs. 2,4-D per acre	Yield (1)	% Germination(1)	Yield	% Germination	Yield	% Germination	Yield	% Germination
Sodium salt	1/4	47.4	93.3	47.9	91.0	43.1	91.7	41.9	92.7
	1/2	51.6	92.7	51.6	91.3	43.6	92.0	43.8	90.7
	1	51.1	93.7	45.7	93.7	42.2	90.7	41.3	91.3
	1 1/2			46.7	93.7				
Ester	1/8			53.8	91.7				
	1/4	46.9	93.3	45.7	91.7	41.1	92.3	43.9	90.0
	1/2	45.0	92.0	47.7	92.7	37.4	88.3	41.2	88.0
	3/4			40.1	89.3				
	1	44.7	91.7	41.8	92.3	38.4	92.7	46.6	93.7

2,4-D as a selective herbicide in winter wheat. (continued) Ab.54

Type of 2,4-D	Rate: lbs. 2,4-D per acre	Stages of Wheat Growth: Pre-fully Tillered Yield (1)	Pre-fully Tillered % Germination(1)	2nd Joint Yield	2nd Joint % Germination	3/4 Headed Yield	3/4 Headed % Germination	10 days Before Harvest Yield	10 days Before Harvest % Germination
Ester	1/8			45.0	91.3				
+ 5 qts.	1/4	50.9	94.0	50.1	92.0	37.2	88.7	46.6	93.0
oil per	1/2	49.4	92.7	47.2	91.3	38.2	91.3	44.5	93.0
acre	3/4			45.5	91.7				
	1	49.6	94.0	42.3	93.0	40.2	83.3	41.4	93.0
No Treatment		50.8	93.7	47.6	93.7	41.1	89.0	44.0	94.0

(1) All data given are averages of three replications.

Ab.55 Controlling annual weeds in winter wheat. Phillips, W. M.

Percentage of weeds killed and average height of weeds present from an experiment using 2,4-D as a selective herbicide in winter wheat at the Fort Hays Experiment Station, Hays, Kansas.

Type of 2,4-D	Rate: lbs. 2,4-D per Acre	Stages of Wheat Growth (1): Pre-fully Tillered % Weeds Killed(2)	Pre-fully Tillered Ave. ht. weeds present inches(2)	2nd Joint % weeds Killed(2)	2nd Joint Ave. ht. weeds present inches(2)	3/4 Headed % weeds Killed(2)	3/4 Headed Ave. ht. weeds present inches(2)
Sodium	1/4	23.3	14.3	21.7	14.7	0	15.7
salt	1/2	46.7	12.0	13.3	11.0	0	20.0
	1	53.3	11.0	14.0	9.7	0	13.7
	1 1/2			83.0	9.0		
Ester	1/8			56.0	12.7		
	1/4	87.3	5.7	80.3	8.7	18.3	11.0
	1/2	94.3	5.0	87.7	4.7	35.0	7.0
	3/4			96.3	3.0		
	1	97.7	3.0	99.0	1.0	60.0	7.6
Ester +	1/8			35.0	13.0		
5 qt. oil	1/4	71.3	9.7	77.3	9.0	20.0	8.0
per acre	1/2	95.0	8.3	82.0	4.3	59.0	8.7
	3/4			92.7	3.0		
	1	98.0	2.0	97.3	3.0	66.7	8.7
No Treatment		0	22.3	0	23.0	0	23.3

(1) Notes taken at the time the wheat was harvested. Weeds sprayed 10 days before harvest were not dead but the leaves were beginning to dry.

(2) All data given are averages of three replications.

Ab.82 A comparason of effect of various treatments on seedling warm season grasses. Vichmeyer, Glenn, McDermand, John,

Forage yield of five warm season grasses receiving various culturd treatments. (Average yield in grams per 8' row 3 replications)

Treatment	Switch	Sand love	Sideoats gramma	Blue gramma	Indian
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Mowed	32.9	147.8	32.4	34.0	16.1
1/2 lb ester	37.8	126.1	41.5	45.7	15.2
1/4 lb. ester	35.9	163.4	48.7	49.3	20.2
1/8 lb ester	25.4	106.1	41.7	56.2	11.2
2.0 lbs. sodium	42.5	154.0	38.1	63.9	25.3
1.0 lb. sodium	54.1	248.8	51.0	75.4	14.8
1/2 lb. sodium	44.6	101.5	42.4	50.6	13.6
1/4 lb. sodium.	26.4	160.9	34.8	85.5	17.6

(Contribution North Platte Substation, Uni of Nebr and Soil Conservation Service)

Summary of Data From Pre-emergence Treatment of Corn With 2,4-D. Urbana, Illinois 1948[a]

Ab. 1

Date of spraying	Pounds of material per acre acid equiv.	Average no. of grass weeds per sq. ft.	Average no. of broadleaved weeds per sq. ft.	Yield, bushel per acre
May 25	Ester 0.33	1.3	1.0	110.2
" 28	" 0.33	2.5	2.4	88.2
" 25	" 0.66	2.7	0.9	109.4
" 28	" 0.66	2.8	1.7	111.3
" 25	" 1.33	1.5	0.5	112.7
" 28	" 1.33	1.2	0.1	111.1
May 25	Amine 0.33	2.6	2.4	107.9
" 28	" 0.33	3.0	2.1	91.7
" 25	" 0.66	1.5	0.2	108.3
" 28	" 0.66	2.5	0.2	107.5
" 25	" 1.33	1.0	1.5	101.9
" 28	" 1.33	1.0	0.0	105.4
May 25	Sodium Salt 0.5	2.0	0.8	110.0
" 28	" " 0.5	1.7	1.0	103.3
" 25	" " 1.0	1.2	0.8	105.1
" 28	" " 1.0	2.2	1.0	119.3
" 25	" " 3.0	1.8	0.5	122.9
" 28	" " 3.0	0.7	1.0	104.0
	One cultivation only	4.0[b]	4.0[b]	109.3
	No treatment or cultivation	3.5	3.0	105.0

a/ May 25--date of planting corn. May 28--three days after planting.
b/ Weeds in corn rows per lineal foot of row.

Contribution of the Dept. of Agron., Ill. Agr. Exp. Sta., R. F. Fuelleman and F. W. Slife.

The Effect of 2,4-D and Contact Dinitro on the Yield and Maturity of Corn When Applied as Pre-emergence Sprays on Three Different Dates

Ab. 4

Treatment	Pounds per acre	Bushels per acre when treated on 3 dates		
		Seeding	3 days after seeding	at emergence
2,4-D	1	68.3	71.2	60.4
2,4-D	2	63.3	68.3	70.3
2,4-D	4	71.7	65.6	69.6
Untreated	-	68.5	76.8	62.9
L.S.D.		15.3	15.3	15.3
Dinitro	1	75.6	76.7	71.1*
Dinitro	2	76.0	69.4	63.4*
Dinitro	4	65.9*	69.6*	69.9*
Untreated	-	78.1	75.6	76.5
L.S.D.		4.9	4.9	4.9

* Significantly lower than untreated at 5% point.

Contribution of the Dept. of Agron., South Dak. Agr. Exp. Sta. Lyle A. Derscheid and D. E. Kratochvil.

The Effect of Pre-emergence 2,4-D on Yields of Corn

Ab. 9

Rate 2,4-D per acre	2,4-D applied at time of planting		2,4-D applied 5 days after planting		Av. both times of application	
	Plants per plot	Yield per acre	Plants per plot	Yield per acre	Plants per plot	Yield per acr
lb.	no.	bu.	no.	bu.	no.	bu.
0	52	64.8	45	67.1	48	66.0
1	52	86.8	54	74.8	53	80.8
2	47	84.4	51	92.2	49	88.3
3	42	71.0	52	81.4	47	76.2
Av. all treated plots	47.0	80.7	52.3	82.8		

Ohio C38, planted May 27, 1948. No cultivation was used on any of the plots. Weeds were the major factor in the yields. The experiment was a randomized block design of 4 replications. Plot size was 3 rows of 10 hills each, with 2 x 10 hills used for stand and yield determinations. The butyl ester was used as a source of 2,4-D. Yields are based on 15 percent moisture.

Contribution of the Dept. of Agron. Ohio Agr. Exp. Sta. Richard J. Aldrich, Warre. C. Shaw, and C. J. Willard.

Use of 2,4-D and Related Materials for Pre-emergence Weed Control in Corn

Ab. 13

Material	Application lb./acre	Cultivation	Corn emergence pct.	Broad-leaved weeds/ sq. ft.	Grassy weeds/ sq. ft.	Yield bu./acre
2,4-D as the sodium salt	1	-	92	1.9**	16.4	20.0**
" " " " "	2	-	94	1.0**	8.6**	36.1**
" " " " "	4	-	87	0.6**	4.3**	40.1**
" " " " "	2	+	93	--	--	58.1
2,4-D as the butyl ester	2	-	92	0.8**	9.2*	39.0*
2,4,5-T as the isopropyl ester	2	-	93	2.7**	8.4**	30.0**
MCP as the isopropyl ester	2	-	90	0.8**	5.9**	33.4**
Check 1	-	-	91	7.1	20.2	18.5
Check 2	-	+	93	-	-	60.8
L. S. D. at the 5 percent level			N. S.	2.5	8.4	9.4
" " " 1 " "			N. S.	3.4	11.4	12.5

Contribution of the Dept. of Agron., Wis. Agr. Exp. Sta., K. P. Buchholtz.

PROJECT IV PRE-EMERGENCE TREATMENTS WITH 2,4-D AND OTHER HERBICIDES TO CONTROL WEEDS IN FIELD CROPS OTHER THAN CORN

Tabular data of Individual Cooperators.

Ab. 19

Spring Wheat

Pre-emergence treatment of spring wheat with 2,4-D and Sinox-W in 1948 at Howard, So. Dakota. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

TREATMENT	YIELD	TEST WEIGHT
Check	20.4	58.5
1/4 lb. 2,4-D acid equiv.	20.2	58.5
1/2 lb. " " "	21.8	58.5
1 lb. " " "	20.1	58.7
1½ lb. " " "	18.5	58.7
2 lb. " " "	19.0	58.2
1/2 gal. Sinox-W	20.3	58.5
1 gal. "	18.4	58.5
2 gal. "	21.2	58.5

No significant difference at 5% level

Ab.20 Pre-emergence treatment of spring wheat with 2,4-D and Sinox-W in 1948 at Orient, So. Dakota. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

TREATMENT	YIELD	TEST WEIGHT
Check	15.9	58.1
1/4 lb. 2,4-D acid equiv.	18.5	57.8
1/2 lb. " " "	15.1	58.5
1 lb. " " "	17.4	57.7
1½ lb. " " "	22.4	57.8
2 lb. " " "	17.1	58.2
1/2 gal. Sinox-W	13.0	58.5
1 gal. "	14.8	58.0
2 gal. "	17.1	57.7

No significant difference at 5% level

Ab. 21 Pre-emergence treatment of spring wheat with 2,4-D and Sinox-W in 1948 at Zap, North Dakota. MacDonald, W. P., Slough, A. T. and Zinter, Clinton. (Contribution of Agr. Dept.,F. H. Peavey and Co., Minneapolis).

TREATMENT	YIELD	TEST WEIGHT
Check	9.8	51.5
1/4 lb. 2,4-D acid equiv.	11.1	52.0
1/2 lb. " " "	11.6	49.5
1 lb. " " "	11.3	50.5
1½ lb. " " "	11.3	51.0
2 lb. " " "	7.1	50.3
1/2 gal. Sinox-W	9.8	56.0
1 gal. "	13.1	55.7
2 gal. "	12.0	50.3

No significant difference at 5% level

Ab. 22 Pre-emergence treatment of spring wheat with 2,4-D and Sinox-W and Sinox General in 1948 at Kragnes, Minn. MacDonald, W. P., Slough, A.T., and Zinter, Clinton. (Contribution of Agr. Dept.,F. H. Peavey and Co., Minneapolis).

TREATMENT	YIELD	TEST WEIGHT
Check	16.2	60.3
1/4 lb. 2,4-D acid equiv.	13.2	60.0
1/2 lb. 2,4-D " "	13.3	60.0
1 lb. " " "	13.9	60.2
1½ lb. " " "	16.7	60.8
2 lb. " " "	12.8	60.3
1/2 gal. Sinox-W	11.8	60.2
1 gal. "	15.9	60.3
2 gal. "	12.6	60.0
1 qt. Sinox General	15.0	60.0
2 qt. " "	16.9	60.0
4 qt. " "	12.6	60.0

No significant difference at 5% level

Ab. 23 Response of spring wheat (1) to systemic (hormone) chemicals applied at different rates to the soil immediately after seeding. Thomas K. Pavlychenko. (Agr. Field Res., Amer. Chem. Paint Co.)

Stage of crop	Chemical Formulation	Rate lbs/a	Plants emerged %	Plants died after emerging %	Condition of surviving plants (3)
One day after seeding	Wc.48 (2)	1	71	0	Slight stunting
	LFN549 (2)	1	66	3	More pronounced stunting
	W#5 (2)	1	68	0	Slight stunting
	Wr.64 (2)	1	64	0	" "
Series 1	LFN472 (2)	1	77	0	Normal development
	95%MSS (2)	1	63	0	" "
	WNM (2)	1	68	0	More pronounced stunting
	Control	0	92	-	-------
Series 2	Wc.48	2	64	2	More pronounced stunting
	LFN549	2	68	5	" " "
	W#5	2	59	1	" " "
	Wr 64	2	61	1	Slight stunting
	LFN472	2	72	0	Normal development
	95%MSS	2	58	0	Slight stunting
	WNM	2	62	1	More pronounced stunting
	Control	0	95	0	-------
One day prior to emergence	Wc.48(2)	1	82	0	Normal development
	LFN549 (2)	1	81	0	" "
	W#5 (2)	1	72	0	" "
Series 3	W-r64(2)	1	72	0	" "
	LFN472 (2)	1	89	0	" "
	95% MSS (2)	1	76	0	" "
	W.N.M. (2)	1	82	0	" "
	Control (2)	0	97	0	---------
Series 4	Wc.48	2	77	0	Young tillers stunted
	LFN549	2	73	4	More pronounced stunting
	W#5	2	68	1	" "
	W-r64	2	74	1	" "
	LFN472	2	83	0	Normal development
	95%MSS	2	76	0	Young tillers stunted
	WNM	2	78	0	" " "
	Control	0	96	0	---------

(1) Weeds present: Common wild mustard (Sinapis arvensis), stinkweed(Thlaspi arvense), lambs quarters (Chenopodium album), redroot pigweed (Amaranthus retroflexus), Russian thistle(Salsola kali), wild buckwheat (Polygonum convolvulus). The three first named weeds were usually 100% controlled. Redroot pigweed and Russian thistle were controlled effectively by the chemicals and competition. Wild buckwheat was controlled probably more by competition than by the chemicals.

(2) Wc.48 = Weedone concentrate 48, ethyl ester; LFN549=ester of 2,4,5-T; W#5= Weedone #5, ethyl ester; Wr64=Weedar 64,amine salt; LFN472=2,4-D acid; 95% MSS =95% monohydrate sodium salt; WNM=Weed-No-More, butyl ester.

(3) A heavy grasshopper damage just prior to maturity prevented yield determinations.

Spring Oats

Ab. 24 Effect of pre-emergence 2,4-D on yields of Clinton oats at Columbus, Ohio. Warren C. Shaw and C. J. Willard (Ohio Agr. Exp. Station).

Rates 2,4-D per acre, acid equivalent	Yield per acre, following treatment with			
	Triethanol amine salt	Sodium salt	Butyl ester	Average all materials
Lb.	Bu.	Bu.	Bu.	Bu.
Check 0	21.2	22.4	22.4	22.0
½	27.5	20.4	26.8	24.9
1	27.8	25.8	29.3	27.6
1½	24.0	28.5	21.9	24.8
2	29.9	28.1	31.2	29.7
4	29.8	21.2	22.3	24.4
Av. all rates	27.8	24.8	26.3	

Pre-emergence treatment of oats with 2,4-D and Sinox-W in 1948 at Howard, So. Dakota. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

Ab. 25

TREATMENT	YIELD(bu.)	TEST WEIGHT(lbs.)
Check	71.8	33.8
1/4 lb. 2,4-D acid equiv.	76.6	33.7
1/2 lb. " " "	71.7	32.7
1 lb. " " "	68.2	32.7
1½ lb. " " "	66.3	32.8
2 lb. " " "	71.3	32.2
1/2 gal. Sinox-W	66.9	33.7
1 gal. "	62.1	33.7
2 gal. "	77.1	33.2

No significant difference at 5% level

Pre-emergence treatment of oats with 2,4-D and Sinox-W in 1948 at Orient, So. Dakota. MacDonald, W. P., Slough, A. T. and Zinter, Clinton. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

Ab. 26

TREATMENT	YIELD	TEST WEIGHT
	Bu.	Lbs.
Check	38.0	27.3
1/4 lb. 2,4-D acid equiv.	41.9	27.3
1/2 lb. " " "	40.1	27.3
1 lb. " " "	38.4	27.5
1½ lb. " " "	42.4	26.2
2 lb. " " "	38.8	26.5
1 gal. Sinox-W	38.7	26.7

No significant difference at 5% level.

Ab. 27 Pre-emergence treatment of oats with 2,4-D and Sinox-W in 1948 at Merrifield, No. Dakota. MacDonald, W. P., Slough, A. T., Zinter, Clinton. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis)

TREATMENT	YIELD Bu.	TEST WEIGHT Lbs.
Check	58.9	32.8
1/4 lb. 2,4-D acid equiv	58.7	32.3
1/2 lb. " " "	57.6	33.0
1 lb. " " "	56.2	33.0
1½ lb. " " "	55.6	32.8
2 lb. " " "	55.2	32.5
1/2 gal. Sinox-W	52.0	32.8
1 gal. "	61.2	32.8
2 gal. "	55.8	32.5

No significant difference at 5% level

Ab. 28 Pre-emergence treatment of oats with 2,4-D and Sinox-W in 1948 at Beulah, No. Dakota. MacDonald, W. P., Slough, A. T. and Zinter, Clinton. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

TREATMENT	YIELD Bu.	TEST WEIGHT Lbs.
Check	33.1	26.7
1/4 lb. 2,4-D acid equiv.	34.4	26.3
1/2 lb. " " "	36.7	25.7
1 lb. " " "	34.3	25.3
1½ lb. " " "	34.6	26.0
2 lb. " " "	37.5	25.7
1/2 gal. Sinox-W	30.2	27.2
1 gal. "	33.0	26.7
2 gal. "	40.2	27.0

No significant difference at 5% level.

Ab. 29 Response of spring oats (1) to systemic (hormone)chemicals applied at different rates to the soil immediately after seeding. Pre-emergence treatments. Thomas K. Pavlychenko. (Agr. Field Res., Amer. Chem. Paint Co.)

Stage of crop	Chemical Formulation	Rate lbs/a	Plants emerged %	Plants died after emergence %	Condition of surviving plants (3)
One day after seeding Series 1	Wc.48 (2)	1	53	4	Medium depression
	LFN549 (2)	1	34	7	Strong "
	W#5 (2)	1	54	3	Medium "
	Wr64 (2)	1	57	2	" "
	LFN472 (2)	1	68	1	Mild depression
	95%MSS (2)	1	48	2	Medium "
	WNM (2)	1	44	5	" "
	Control	0	87	0	———
Series 2	Wc.48	2	45	6	Strong depression
	LFN549	2	31	8	Very strong depression
	W#5	2	47	4	Strong depression
	Wr64	2	46	3	Medium "
	LFN472	2	64	2	Mild depression
	95%MSS	2	51	2	Medium "
	WNM	2	43	7	Strong "
	Control	0	88	0	———
One day prior to emergence Series 3	Wc.48 (2)	1	72	0	Mild stunting
	LFN549 (2)	1	68	5	Medium "
	W#5 (2)	1	68	2	Mild "
	Wr.64 (2)	1	66	1	" "
	LFN472 (2)	1	77	0	Normal growth
	95%MSS (2)	1	63	1	Mild stunting
	WNM (2)	1	71	2	Medium "
	Control	0	89	0	———
Series 4	Wc.48	2	68	2	Mild stunting
	LFN549	2	56	4	Medium "
	W#5	2	61	2	" "
	Wr 64	2	64	3	Mild "
	LFN472	2	69	1	Normal growth
	95%MSS	2	63	3	Mild "
	WNM	2	69	4	Medium stunting
	Control	0		0	———

(1) Weeds present: Common wild mustard (sinapis arvensis), stinkweed (Thlaspi arvense), lamb's quarters (Chenopodium album), redroot pigweed (Amaranthus retroflexus), Russian thistle (Salsola kali), wild buckwheat (Polygonum convolvulus). The three first named weeds were 100% controlled by most of the chemicals. Redroot pigweed and Russian thistle were controlled effectively by the chemicals and competition from the crop. Wild buckwheat was quite satisfactorily controlled probably more by competition than by the chemicals.

(2) Wc.48=Weedone concentrate 48, ethyl ester; LFN549=ester of 2,4,5-T; W#5 = Weedone #5 ethyl ester; Wr64= Weedar 64, amine salt; LFN472=2,4-D acid; 95%MSS = 95% monohydrate sodium salt; WNM = Weed-No-More, butyl ester.

(3) A heavy grasshopper damage prevented yield determinations.

Spring Barley

Ab. 30 Pre-emergence treatment of barley with 2,4-D and Sinox-W in 1948 at Beulah, No. Dakota. MacDonald, W. P., Slough, A.T. and Zinter, Clinton. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis)

TREATMENT	YIELD	TEST WEIGHT
	Bu.	Lbs.
Check	13.3	38.6
1/4 lb. 2,4-D acid equiv.	14.7	37.0
1/2 lb. " " "	14.1	39.0
1 lb. " " "	13.6	33.0
1½ lb. " " "	13.4	37.0
2 lb. " " "	15.1	35.3
2 gal. Sinox-W	13.8	37.7

No sifnificant difference at 5% level

Ab. 31 Pre-emergence treatment of barley with 2,4-D and Sinox-W in 1948 at Howard, So. Dakota. MacDonald, W. P., Slough, A. T. and Zinter, Clinton. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis)

TREATMENT	YIELD	TEST WEIGHT
	Bu.	Lbs.
Check	31.8	43.0
1/4 lb. 2,4-D acid equiv.	29.0	42.3
1/2 lb. " " "	33.3	42.5
1 lb. " " "	37.6*	43.2
1½ lb. " " "	41.2**	42.3
2 lb. " " "	35.7	42.2
1/4 gal. Sinox-W	34.2	42.5
1 gal. "	30.4	42.8
2 gal. "	30.1	42.7

* Significantly higher at 5% level
** Very significantly higher at 5% level

Ab. 32 Pre-emergence treatment of barley with 2,4-D and Sinox-W in 1948 at Orient, So. Dakota. MacDonald, W. P., Slough, A. T. and Zinter, Clinton, (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

TREATMENT	YIELD	TEST WEIGHT
	Bu.	Lbs.
Check	33.2	41.9
1/4 lb. 2,4-D acid equiv.	32.2	41.7
1/2 lb. " " "	31.7	41.5
1 lb. " " "	32.8	41.2
1½ lb. " " "	35.0	42.0
2 lb. " " "	34.0	41.7
1/2 gal. Sinox-W	32.8	42.5
1 gal. "	32.0	41.2
2 gal. "	30.7	41.3

No significant difference at 5% level.

Ab.33 Pre-emergence treatment of barley with 2,4-D and Sinox-W in 1948 at Kragnes, Minn. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis).

TREATMENT	YIELD	TEST WEIGHT
	Bu.	Lbs.
Check	40.5	41.6
1/4 lb. 2,4-D acid equiv.	39.7	42.0
1/2 lb. " " "	40.6	41.5
1 lb. " " "	36.9*	42.2
1½ lb. " " "	36.7*	41.7
2 lb. " " "	41.7	41.2
1/2 gal. Sinox-W	37.0	42.5
1 gal. "	39.4	42.2
2 gal. "	38.0	42.0

* Significantly lower at 5% level

Ab. 34 Response of barley to systemic (hormone) chemicals applied at different rates to the soil immediately after seeding. Pre-emergence treatments. Thomas K. Pavlychenko (Agr. Field Res., Amer. Chem. Paint Co.)

Stage of crop	Chemical Formulation	Rate lbs/a	Plants emerged %	Plants died after emergence %	Condition of surviving plants (3)
One day after seeding	Wc.48 (2)	1	74	3	Medium depression
	LFN549 (2)	1	71	6	Strong "
	W#5 (2)	1	72	4	Medium "
	Wr.64 (2)	1	70	3	Mild "
Series 1	LFN472 (2)	1	82	0	Normal growth
	95%MSS (2)	1	73	0	Mild depression
	WNM (2)	1	75	4	Medium "
	Control	0	97	0	------
Series 2	Wc.48	2	70	3	Medium depression
	LFN549	2	65	8	Strong "
	W#5	2	69	6	Medium "
	Wr64	2	63	3	" "
	LFN472	2	76	1	Normal growth
	95% MSS	2	68	2	Mild depression
	WNM	2	66	6	Strong "
	Control	0	98	0	------
One day prior to emergence	Wc.48 (2)	1	87	0	Normal growth
	LFN549 (2)	1	83	4	Mild depression
	W#5 (2)	1	85	2	Normal growth
	Wr.64 (2)	1	88	0	" "
Series 3	LFN472 (2)	1	91	0	" "
	95%MSS (2)	1	86	0	" "
	WNM (2)	1	87	2	" "
	Control	0	98		------
Series 4	W c.48	2	84	2	Normal growth
	LFN549	2	80	5	Medium depression
	W#5	2	81	2	Mild depression
	Wr64	2	80	2	" "
	LFN472	2	89	1	Normal growth
	95%MSS	2	83	2	Mild depression
	WNM	2	85	3	" "
	Control	0	96		------

(1) Weeds present: Common wild mustard (Sinapis arvensis), stinkweed (Thlaspi arvense), lamb's quarters (Chenopodium album), Redroot pigweed (Amaranthus retroflexus), Russian thistle (Salsola kali), wild buckwheat (Polygonum convolvulus). The three first named weeds were 100% controlled by most of the chemicals. Redroot pigweed and Russian thistle were controlled effectively by the chemicals and competition from the crop. Wild buckwheat was quite satisfactorily controlled probably more by competition than by chemicals.

(2) Wc.48=Weedone concentrate 48, ethyl ester; LFN549=ester of 2,4,5-T; W#5 = Weedone #5 ethyl ester; Wr64=Weedar 64, amine salt; LFN472=2,4-D acid; 95%MSS = 95% monohydrate sodium salt; WNM= Weed-No-More, butyl ester.

(3) A heavy grasshopper damage prevented yield determinations.

Ab.35 Response of Spring Rye (1) to systemic (hormone) chemicals applied at different rates to the soil immediately after seeding. Pre-emergence treatments. Thomas K. Pavlychenko (Agric. Field Res., Amer. Chem. Paint Co.)

Stage of crop	Chemical Formulation	Rate lbs/a.	Plants emerged %	Plants died after emergence %	Condition of surviving plants (3)
One day after seeding Series 1	Wc.48 (2)	1	59	2	Tillering reduced slightly
	LFN549 (2)	1	54	6	" " "
	W#5 (2)	1	54	3	" " "
	Wr64 (2)	1	56	1	" " "
	LFN472 (2)	1	69	0	Normal growth
	95%MSS (2)	1	58	2	Tillering reduced slightly
	WNM (2)	1	60	3	" " "
	Control	0	76	-	———
Series 2	Wc.48	2	52	4	Tillering reduced
	LFN549	2	49	7	" " greatly
	W#5	2	46	4	" " "
	Wr64	2	51	3	" "
	LFN472	2	57	1	" " slightly
	95%MSS	2	45	4	" "
	WNM	2	53	4	" " greatly
	Control	0	—	—	———
One day prior to emergence Series 3	Wc.48 (2)	1	68	0	Normal growth
	LFN549 (2)	1	66	4	Tillering reduced slightly
	W#5 (2)	1	63	2	Normal growth
	Wr64 (2)	1	67	2	" "
	LFN472 (2)	1	71	0	" "
	95% MSS (2)	1	64	1	" "
	WNM (2)	1	65	2	" "
	Control	0	72	0	———
Series 4	Wc.48	2	64	3	Tillering reduced slightly
	LFN549	2	67	5	" "
	W#5	2	61	2	" "
	Wr64	2	65	1	Normal growth
	LFN472	2	71	0	" "
	95%MSS	2	62	1	" "
	WNM	2	64	2	Tillering reduced
	Control	0	74	0	———

(1) Weeds present: Common wild mustard (Sinapis arvensis, stinkweed (Thlaspi arvense), lamb's quarters (Chenopodium album), redroot pigweed(Amaranthus retroflexus), Russian thistle (Salsola kali), Wild buckwheat (Polygonum convolvulus). The three first named weeds were 100% controlled by most of the chemicals. Redroot pigweed and Russian thistle were controlled effectively by the chemicals and competition from the crop. Wild buckwheat was quite satisfactorily controlled probably more by competition than by the chemicals.

(2) Wc.48=Weedone concentrate 48, ethyl ester; LFN549=ester of 2,4,5-T; W#5 = Weedone #5, ethyl ester; Wr64=Weedar, amine salt; LFN472=2,4-D acid; 95%MSS = 95% monohydrate sodium salt; WNM = Weed-No-More, butyl ester.

(3) A heavy grasshopper damage just prior to maturity, prevented yield determinations.

Ab.38 Effects of 2,4-D, TCA, IPC and contact dinitro on the yields and test weight of flax, when applied as pre-emergence sprays. Derscheid, Lyle A., L. M. Stahler, D. E. Kratochvil. (Contributed by Agronomy Department of South Dakota Agricultural Experiment Station and Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. D.A.

Treatment	Pounds per acre	Bushels per acre	
		Seeding time	3 days after seeding
2,4-D	1	12.0	12.1
2,4-D	2	12.8	11.6
2,4-D	4	10.2	11.2
Untreated	-	15.8	15.1
L.S.D.		6.75	6.75
TCA	6	11.4*	11.7
TCA	12	9.5*	8.8*
TCA	24	8.4*	8.4*
Untreated	—	14.8	12.4
L.S.D.		3.00	3.00
IPC	2	12.4	10.5
IPC	4	13.3	12.6
IPC	8	6.9	9.3
Untreated	-	11.2	13.7
LSD		5.5	5.5
Diditro	1	13.3	14.4
Dinitro	2	12.0	12.8
Dinitro	4	9.9	14.5
Untreated	-	13.3	14.5
L.S.D.		4.25	4.25

* Significantly lower, at 5% point, than untreated

Ab.39 Pre-emergence treatment of Golden and B-5128 flax with 2,4-D and Sinox-W in 1948 at Beulah, No. Dakota. MacDonald, W. P., Slough, A. T. and Zinter, Clinton. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis)

TREATMENT	YIELD	
	Golden	B-5128
	Bu.	Bu.
Check	7.3	8.3
1/4 lb. 2,4-D acid equiv.	7.2	8.5
1/2 lb. " " "	7.8	8.3
1 lb. " " "	7.0	8.1
1½ lb. " " "	6.2	9.2
2 lb. " " "	6.8	8.1
1/2 gal. Sinox-W	7.2	6.9
1 gal. "	7.7	8.6
2 gal. "	8.2	10.1

No significant difference at 5% level.

Ab. 40 Pre-emergence treatment of flax with 2,4-D and Sinox-W in 1948 at Howard, So. Dakota. MacDonald, W. P., Slough, A. T., and Zinter, Clinton. (Contribution of Agr. Dept., F. H. Peavey and Co., Minneapolis)

TREATMENT	YIELD
	Bu.
Check	18.2
1/4 lb. 2,4-D acid equiv.	18.3
1/2 lb. " " "	19.8
1 lb. " " "	18.9
1½ lb. " " "	19.4
2 lb. " " "	20.9
1/4 gal. Sinox-W	18.6
1/2 gal. "	17.6
1 gal. "	20.0

No significant difference at 5% level

Ab. 41 Response of Royal flax (1) to systemic (hormone) chemicals applied at different rates to soil immediately after seeding. Pre-emergence treatments. Thomas K. Pavlychenko (Agr. Field Res., Amer. Chem. Paint Co.)

Stage of crop	Chemical Formulation	Rate lbs./a.	Plants emerged %	Plants died after emergence %	Condition of surviving plants
One day after seeding	Wc.48 (2)	1	22	7	3 inches stunted
	LFN549 (2)	1	18	20	4 inches stunted
	W#5 (2)	1	26	21	Slightly stunted
	Wr64 (2)	1	26	18	2 inches stunted
	LFN472 (2)	1	49	3	Slender taller
	95%MSS (2)	1	28	6	Slightly stunted
	WNM (2)	1	12	32	6 inches stunted.
	Control	0	89	0	———
	Wc.48	2	17	18	4 inches stunted
	LFN549	2	12	31	6 inches stunted
	W#5	2	45	38	4 inches stunted
	Wr64	2	21	23	slightly stunted
	LFN472	2	23	16	Normal growth
	95%MSS	2	13	15	Slightly stunted
	WNM	2	8	43	Serious stunting
	Control	0	78	0	———
One day before emergence	Wc.48 (2)	1	68	2	Normal growth
	LFN549	1	53	5	Slightly stunted
	W#5	1	64	3	Normal growth
	Wr64	1	76	0	" "
	LFN472	1	84	0	" "
	95% MSS	1	73	0	" "
	WNM	1	59	4	" "
	Control	0	91	0	———
	Wc.48	2	69	3	Slightly stunted
	LFN549	2	46	5	3 inches stunted
	W#5	2	61	4	Slightly stunted
	Wr64	2	71	1	Slightly stunted
	LFN472	2	79	0	Normal growth
	95% MSS	2	70	2	Slightly stunted
	WNM	2	61	4	" "
	Control	0	89	0	———

(1) Weeds present: Common wild mustard (Sinapis arvensis), stinkweed (Thlaspi arvense), lamb's quarters (Chenopodium album), redroot pigweed(Amaranthus retroflexus), RussianThistle (Salsola kali), wild buckwheat (Polygonum convolvulus). The three first named weeds were almost 100% controlled by most chemicals in this test. A low percentage of redroot pigweed and Russian thistle emerged and survived but the plants were seriously stunted. Wild buckwheat emerged almost 40 days after the treatments; many of the seedlings survived and frew well.

(2) Wc.48=Weedone concentrate 48 ethyl ester; LFN549 = ester of 2,4,5-T; W#5 = Weedone #5, ethyl ester; Wr64 = Weedar 64, amine salt; LFN472 = 2,4-D acid; 95% MSS = 95% monohydrate sodium salt; WNM = Weed-No-More, butyl ester.

Ab.43 Pre-emergence spraying of soybeans with 2,4-D. Slife, W. F. and R. F. Fuelleman. (Ill. Agr. Exp. Sta.)

Formulation	Rate acid/acre lbs.	Average Yield bus./acre	Weed Control
Ester (uncultivated)	3/4	36.8	poor
	1½	33.5	fair
	3	36.2	good-excellent
Sodium salt (uncultivated)	3/4	35.1	poor
	1½	35.2	fair
	3	38.1	good
Check (uncultivated)	0	34.3	poor

Effect of pre-emergence sprays with two formulations of 2,4-D on onions. Anderson, E. T. and A. B. Mantell.
Ab. 8

2,4-D (lbs./acre)	Av. Plot Yields in lbs. of Onion Bulbs			
	First date		Second date	
	Ester	Sodium Salt	Ester	Sodium Salt
0.25	19.4	10.4	14.0	19.9
0.50	11.1	7.3	19.1	18.9
1.00	5.3	2.4	8.6	17.4

Mean of combined checks - 18.9
Necessary difference - 3.98
Significantly different from mean of combined checks

Effect of pre-emergence sprays with two formulations of 2,4-D on sweet corn. Anderson, E. T. and A. B. Mantell.
Ab. 7

2,4-D (lbs./acre)	Av. Plot Yields in lbs. of Corn Kernels			
	First date		Second rate	
	Ester	Sodium Salt	Ester	Sodium Salt
0.25	8.00	7.75	7.31	7.94
0.50	8.13	7.06	7.94	7.25
1.00	7.50	7.75	7.13	7.44
2.00	6.94	8.00	8.00	7.13

Mean of combined checks - 7.29
Necessary difference - 1.63

A study on the control of weed in onions. Hylund, R. E.

Ab. 11

Herbicide applied**		Mean* number weeds per rod row five days after		Mean* no. onion plants per rod row in plots receiving:		Mean* lbs. onions per rod row from plots receiving:	
First application (5/24)	Second application (6/1)	First application	Second application	One Application	Two applications	One application	Two applications
Untreated	Untreated	346	455	56	60	16.0	14.6
3% H_2SO_4	3% H_2SO_4	119	20	64	59	18.5	17.1
1% A_oCy	2% A_oCy	356	119	58	68	16.6	18.7
2% A_oCy	4% A_oCy	208	20	58	39	16.6	9.8
3% A_oCy	6% A_oCy	238	20	57	26	15.8	6.4
25% NaCl	25% NaCl	515	257	55	59	15.4	16.7
25% KCl	25% KCl	396	346	50	58	14.4	15.2
1.5% Dow A	3% Dow A	297	148	64	48	18.1	13.2
2% Dow A	4% Dow A	307	69	52	41	15.0	9.7
3/4% Dow B	1½% Dow B	337	50	56	43	16.6	11.8
1% Dow B	2% Dow B	297	30	55	42	14.7	11.6
1½% Dow B	3% Dow B	139	40	52	14	15.8	4.1
2% Dow B.	2% Dow B	79	20	49	35	13.5	10.5
3/4% Dow F	1½% Dow F	475	248	48	61	13.6	16.8
1% Dow F	2% Dow F	317	109	57	59	16.8	16.7
1½% Dow F	3% Dow F	307	59	49	40	14.1	12.2
L.S.D.	5% level	139	139	12	12	3.6	3.6
L.S.D.	1% level	178	178	16	16	4.7	4.7

* All data are means of 8 one-rod-row plots

** AoCy - Acro Cyanate (potassiam cyanate)
Dow A - Sodium orthophenylphenate
Dow B - Sodium 2,4,5 trichlorphenate
Dow F - Sodium 2,3,4,6 tetrachlorphenate

A study on the control of weeds in beets, onions, and carrots by pre-emergence applications of herbicides. Nylund, R. E.

Ab. 17

Treatment**	Mean no. weeds / 6"x 20" frames*	Beets No. plants/ rod row	Beets Tons/ acre	Carrots No. plants/ rod row	Carrots Tons/ acre	Onions No. plants/ rod row	Onions Bu. / acre
Untreated	137	57	6.7	34	3.9	30	236
Weed burner	37	39	4.9	38	4.8	33	264
Stoddard solvent	" 53	59	6.2	31	3.5	46	384
Amsco D (1)	22	45	5.3	32	3.8	14	126
1# 2,4-D/acre (2)	121	24	2.6	37	3.9	26	203
2# 2,4-D/acre (2)	58	29	2.3	13	1.5	19	188
4# 2,4-D/acre (2)	39	18	1.6	7	.7	8	59
3% Dowicide F (3)	16	13	1.8	4	.5	11	86
3% Dowicide G (4)	8	6	1.0	2	.3	2	20
3% Dowicide B (5)	24	26	3.4	22	2.4	17	136
2% Dow Contact	16	16	2.4	21	2.6	12	94
20% H.A.N. #132 (6)	36	43	5.2	20	2.3	20	162
L.S.D.5 % level	36	22	3.0	25	2.8	n.s.	n.s.
L.S.D. 1% level	46	28	3.9	32	3.6	-	-

* Weed counts made 18 days after application of herbicides.

** All materials applied at 80 gallons per acre except 20% H.A.N. #132 which was applied at 160 gallons per acre.

(1) A petroleum oil containing 68% aromatics; boiling range 310° - 410° F.
(2) Applied in form of sodium salt.
(3) Sodium 2,3,4,6 tetrachlorphenate.
(4) Sodium pentachlorophenate
(5) Sodium 2,4,5 trichlorophenate.
(6) Naphtha-type oil containing 83% aromatics; boiling range 338° - 544° F. (The oil emulsified in water using Atlas Tween #40)

Conditions of experiment: Temperature at time of application 50° F., relative humidity approximately 99, soil moderately moist. Each treatment applied to square rod plots in four randomized blocks, each square rod containing three rows each of beets, carrots and onions. Center row of each crop harvested for yield data. Varieties grown were: beets - Detroit Dark Red, carrots - Nantes, onion - Southport Yellow Globe (Brigham strain).

A study on the use of 2,4-D for weed control in strawberries. Nylund, R. E.

Ab. 21

Treatment

Lbs. 2,4-D/acre	Formulation	Date applied	Number broad-leaved weeds per rod row on:- * 7/14	7/23	8/24	No. leaves per strawberry plant on 8/11**	No. runner plants per plant on 8/11**	No. runner plants per plant on 10/21**
0	—	—	192	5	87	7.2	3.0	7.8
1/4	Isopropyl ester	7/9&8/11	207	104	16	7.1	3.0	11.4
1/2	"	"	151	68	15	5.3	2.3	8.7
1	"	7/9	134	11	7	7.2	3.2	9.0
1	Sodium salt	7/9 & 8/11	118	46	9	7.4	2.5	10.4
2	"	7/9 & 8/11	151	19	2	7.2	2.6	6.2
3	"	7/9	89	1	1	7.0	2.0	7.1
4	"	7/9	131	2	1	7.2	1.6	8.1
	L. S. D. 5% level		49	25	14	n.s.	n.s.	3.2
	L. S. D. 1% level		65	33	19	—	—	4.3

* Data given are means of 10 replications and are based on weed counts obtained within the area covered by two 6"x 20" frames.

** Data given are means of 5 replications and are based on counts of 5 plants in each plot.

Conditions of experiment: Variety: Arrowhead; planted June 21. 1st application: Temperature 85°F., soil wet (.44" rain in preceding 24 hours), humidity high, clear day. 2nd application: Temperature 75°F., soil wet (1.67" rain in preceding 24 hours), clear day. Untreated plots hoed on July 14 and grasses pulled in all plots on July 14 and on August 24. 2,4-D applied in 80 gallons water per acre. Plot size: single 30' row.

Legumes

33 The effects of 2,4-D and TCA on the yield of nine soybean varieties. Derscheid, Lyle and D. L. Kratochvil.

Variety	¼ # 2,4-D	½# 2,4-D	6 # TCA	16# TCA	Untreated	L.S.D. 5%	L.S.D. 1%
Capital	19.0*	10.3**	4.2**	0.9**	27.9	7.7	9.0
Hawkeye	14.3*	6.8**	3.6**	0.6**	27.4	7.7	9.0
Lincoln	22.0	11.4**	2.2**	3.2**	23.7	7.7	9.0
Manchukota	16.9	10.4**	2.4**	0.5**	23.0	7.7	9.0
Richland	19.9**	17.6**	1.2**	3.1**	29.8	7.7	9.0
Ottawa Mandarin	16.8**	11.2**	2.6**	3.3**	26.8	7.7	9.0
Flambeau	18.9*	8.1**	4.5**	0.7**	26.7	7.7	9.0
Earlyana	17.2*	10.2**	4.2**	1.1**	26.1	7.7	9.0
Lavender Special	29.8	17.1**	2.2**	0.1**	28.9	7.7	9.0
Average	19.4**	11.5**	3.0**	1.3**	26.3	3.8	5.5

* Significantly lower than untreated yield at 5% point
** Significantly lower than untreated yield at 1% point
(Contri. by Agronomy Dept. of S. Dak. Agri. Exp. Station)

37
Effect of pre-emergence sprays with two formulations of 2,4-D on garden peas. Andersen, E. T. and A. B. Mantell.

2,4-D (lbs. /acre)	Average plot yields in pounds of pea pods — First date: Ester	First date: Sodium Salt	Second date: Ester	Second date: Sodium Salt
0.25	12.8	13.3	13.8	13.8
0.50	11.5*	11.9*	13.4	10.6*
1.00	9.1*	7.9*	12.0	13.4

Means of combined checks - 13.4
Necessary difference - 1.64
*Significantly different from mean of combined checks.

(Contri. of Division of Plant Science, University of Manitoba, Winnipeg)

Summary of Weed Control Investigations in Sugar Beets at Fargo, N. D. and East Grand Forks, Minn. Conducted During the Summer, 1948.

C. R. Swanson, E. A. Helgeson, L. M. Stahler.
Contr. of Div. of Cereal Crops & Dis., Bureau of Plant Industry Soils and Agr. Eng., U.S.D.A. and North Dakota Agricultural Experiment Station cooperating.

42
Pre-emergence - Fargo

Treatment	Rate	Date of Application	Ave. no. weeds per sq. meter Broadleaf	Grass	Ave. no. beets per sq. meter	Wt. of 15 beet sample lbs.	Sugar %
NaTCA	.6#/A	1 da. after plant.	34.0	77.3	27.0	26.0	19.0
		2	23.0	15.3	27.3	19.8	19.15
		5	37.0	33.0	27.7	23.5	19.75
		8	34.0	94.7	26.0	22.8	19.9
		Average	32.0	55.1	27.0	23.02	19.45
	12#/A	1	24.3	120.0	14.3	21.5	19.7
		2	22.3	53.3	24.0	17.4	19.0
		5	25.3	48.3	31.3	20.2	18.4
		8	11.7	27.3	31.0	19.5	19.0
		Average	20.9	62.2	25.2	19.65	19.03
	24#/A	1	5.7	32.0	22.3	20.9	20.0
		2	9.0	54.3	31.7	15.3	20.25
		5	9.7	18.7	24.7	24.0	18.2
		8	8.3	22.0	24.0	21.4	19.6
		Average	8.2	31.8	25.7	20.40	19.51
	48#/A	1	7.3	6.0	22.3	20.0	18.5
		2	9.0	2.0	18.7	15.0	18.7
		5	11.3	5.7	15.0	13.5	18.6
		8	13.7	9.0	18.3	10.9	20.1
		Average	10.3	5.7	18.6	14.85	19.00
	96#/A	1	7.0	3.0	15.0	11.3	18.4
		2	6.7	5.3	13.3	14.1	19.1
		5	4.3	6.0	13.3	16.0	18.4
		8	8.7	5.0	15.7	12.1	18.4
		Average	6.7	4.8	14.3	14.37	18.58
NH_4TCA	6#/A	1	7.3	17.0	31.0	15.5	19.7
		2	11.0	42.0	31.3	16.0	20.5
		5	9.7	31.3	28.0	18.8	19.8
		8	8.7	15.3	20.7	12.5	19.55
		Average	9.2	26.0	27.8	15.70	19.89

42-cont.

Treatment	Rate	Date of Application	Ave. no. weeds per sq. meter Broadleaf	Grass	Ave. no. beets per sq. meter	Wt. of 15 beet sample lbs.	Sugar %
Sinox W	4#/A	5 da. after plant.	34.0	110.0	22.3		
		6	16.3	65.7	29.3		
		8	21.3	47.3	20.3		
		Average	23.9	74.3	24.0		
Shell ACX-170	50 gal.	5	22.3	56.3	28.0		
		6	29.3	83.7	25.7		
		Average	25.8	70.0	26.9		
	100 gal.	5	8.0	42.3	16.7		
		6	12.3	34.7	23.0		
		Average	10.2	38.5	19.9		
Shell ACX-184	50 gal.	5	6.3	55.3	24.7		
		6	11.3	114.3	35.7		
		Average	8.8	84.8	30.2		
	100 gal.	5	11.7	90.0	16.0		
		6	13.0	83.0	22.0		
		Average	12.4	86.5	19.0		
Controls (Average)			20.6	68.2	30.3	17.87	18.54
Pre-emergence - East Grand Forks							
Cyanamid	75# /A	2	12.0	9.0	7.0		
		6	12.0	6.7	8.7		
		Average	12.0	7.9	7.9		
	100#/A	2	13.3	6.0	4.0		
		6	7.3	5.7	11.0		
		Average	10.3	5.9	7.5		
	150#/A	2	21.7	5.7	12.7		
		6	14.7	8.3	3.7		
		Average	18.2	7.0	8.2		
Sinox G	1#/A	4	3.7	0.3	19.3		
		8	5.3	1.0	8.7		
		Average	4.5	0.7	14.0		
	2#/A	4	0.7	0.3	15.3		
		8	1.0	0.0	5.7		
		Average	0.9	0.2	10.5		

42-cont.
Pre-emergence - Fargo

Treatment	Rate	Date of Application	Ave. no. weeds per sq. meter Broadleaf	Grass	Ave. no. beets per sq. meter	Wt. of 15 beet sample lbs.	Sugar %
NH_4TCA	12#/A	1 da. after plant.	7.0	22.7	32.7	17.5	20.0
		2	14.0	25.3	32.3	14.0	19.9
		5	36.3	29.7	29.7	15.3	19.45
		8	--	--	--	16.0	18.0
		Average	19.1	25.9	31.6	15.70	19.34
	24#/A	1	12.7	13.3	14.0	21.5	18.6
		2	28.7	26.3	12.0	24.3	19.3
		5	31.0	35.3	22.7	19.3	19.5
		8	53.3	10.0	23.3	21.0	19.1
		Average	31.4	21.2	18.0	21.52	19.12
	48#/A	1	87.3	11.7	24.3	17.3	18.2
		2	60.7	19.7	22.3	20.0	17.85
		5	22.0	6.0	21.0	15.0	20.0
		8	14.7	4.3	16.7	16.1	17.3
		Average	46.2	10.4	21.1	17.12	18.34
	96#/A	1	18.7	2.3	19.3	16.6	19.45
		2	26.3	1.7	16.3	13.5	18.2
		5	24.0	0.7	20.7	16.9	18.0
		8	16.7	1.7	10.3	18.5	19.0
		Average	21.4	1.6	16.6	16.37	18.66
Sinox G	1#/A	5	7.3	60.7	20.0	19.3	17.8
		6	8.7	50.0	17.0	17.4	19.4
		8	4.0	60.3	16.0	17.8	19.95
		Average	6.7	57.0	17.7	18.17	19.05
	2#/A	5	10.3	40.0	27.0	15.0	20.6
		6	6.0	39.7	36.3	12.5	20.1
		8	3.7	30.3	23.7	18.0	21.0
		Average	6.7	36.7	29.0	15.17	20.06
	4#/A	5	5.3	65.7	29.3	13.3	19.1
		6	12.3	54.3	27.3	12.9	20.8
		8	30.0	52.7	24.0	14.3	19.3
		Average	15.9	57.6	26.9	13.50	19.73
Sinox W	1#/A	5	7.3	59.7	28.3		
		6	8.7	38.7	13.3		
		8	6.3	22.7	14.3		
		Average	7.4	40.4	18.6		
	2#/A	5	45.3	50.7	25.3		
		6	47.7	81.0	28.0		
		8	40.7	99.7	16.3		
		Average	44.6	77.1	23.2		

42-cont.

Pre-emergence - East Grand Forks

Treatment	Rate	Date of Application	Ave. no. weeds per sq. meter Broadleaf	Grass	Ave. no. beets per sq. meter	Wt. of 15 beet sample lbs.	Sugar %
Sinox G	4#/A	4 da. after plant.	0.3	0.0	10.3		
		8	1.0	0.0	4.3		
		Average	0.7	0.0	7.3		
Sinox W	1#/A	4	18.7	7.7	21.3		
		8	3.3	10.3	5.7		
		Average	11.0	9.0	13.5		
	2#/A	4	11.0	5.7	24.7		
		8	25.0	11.0	11.7		
		Average	18.0	8.4	18.2		
	4#/A	4	16.0	7.0	25.0		
		8	7.7	10.0	12.0		
		Average	11.9	8.5	18.5		
Pentachlorophenate	4#/A	Immed. after plant.	51.3	5.0	21.0		
		4 days " "	7.3	7.3	22.3		
		Average	29.3	6.2	21.7		
	8#/A	Immed.	19.7	5.0	21.7		
		4 days	10.0	5.0	20.7		
		Average	14.9	5.0	21.2		
	12#/A	Immed.	13.0	5.3	25.3		
		4 da.	5.0	6.7	19.0		
		Average	9.0	6.0	22.2		
NaTCA	6#/A	Immed.	16.7	5.7	11.3		
		2 days	25.3	8.3	25.0		
		4 days	16.0	7.7	21.0		
		Average	19.3	7.2	19.1		
	12#/A	Immed.	43.0	10.3	23.7		
		2 days	36.7	1.3	24.0		
		4 days	13.0	6.3	30.7		
		Average	30.9	6.0	26.1		
	24#/A	Immed.	17.7	13.7	27.0		
		2 days	32.0	2.7	21.3		
		4 days	16.7	1.0	32.7		
		Average	22.1	5.8	27.0		
	48#/A	Immed.	9.3	3.7	21.3		
		2 days	3.3	1.3	16.0		
		4 days	24.0	5.0	26.0		
		Average	12.2	3.3	21.1		

42-continued.

Pre-emergence - East Grand Forks

Treatment	Rate	Date of Application	Ave. no. weeds per sq. meter Broadleaf	Grass	Ave. no. beets per sq. meter	Wt. of 15 beet sample lbs.	Sugar %
NaTCA	96#/A	Immed. after plant.	18.7	7.0	21.3		
		2 days	2.7	1.7	21.3		
		4 days	18.3	2.7	21.3		
		Average	13.2	3.8	21.3		
NH_4TCA	6#/A	Immed.	16.3	5.3	27.7		
		2 days	13.0	3.7	18.0		
		4 days	27.0	2.3	25.7		
		Average	18.8	3.8	23.8		
	12#/A	Immed.	17.3	8.3	22.3		
		2 days	11.3	2.0	30.0		
		4 days	35.3	8.7	24.3		
		Average	21.3	6.3	25.5		
	24#/A	Immed.	18.3	12.3	21.3		
		2 days	16.0	8.3	25.0		
		4 days	20.7	4.7	27.7		
		Average	18.3	8.4	24.3		
	48#/A	Immed.	10.7	8.3	20.7		
		2 days	21.0	2.7	25.0		
		4 days	27.7	5.3	21.0		
		Average	19.8	5.4	22.2		
	96#/A	Immed.	8.3	2.3	25.7		
		2 days	7.7	9.0	26.7		
		4 days	12.3	2.3	26.7		
		Average	9.4	4.5	26.4		
Controls (Average)			40.5	2.0	19.3		

Table 43.

Post-emergence - Fargo

ACX-184	16 gal./ acre	Immed. after block.			12.2	19.2
		3 wks. after			11.5	20.2
		Average			11.85	19.70
	32 gal./ acre	Immed. after block.			14.1	18.9
		3 wks. after			20.6	18.9
		Average			17.35	18.90

43-continued.

Post-emergence - Fargo

Treatment	Rate	Date of Application	Ave. no. weeds per sq. meter Broadleaf	Grass	Ave. no. beets per sq. meter	Wt. of 15 beet sample lbs.	Sugar %
NaTCA	6#/A	Immed. after block.				14.9	18.7
		3 wks. after				19.8	17.8
		6 wks. after				12.8	19.6
		Average				15.83	18.70
	8#/A	Immed. after block.				17.3	18.6
		6 wks. after				12.6	18.35
		Average				14.50	18.48
	16#/A	Immed. after block.				14.7	18.5
		6 wks. after				9.9	19.1
		Average				12.30	18.80
NH_4TCA	4#/A	Immed. after block.				19.5	18.5
		3 wks. after				9.9	19.8
		6 wks. after				15.5	19.0
		Average				14.97	19.10
	6#/A	Immed. after block.				13.0	19.5
		3 wks. after				7.7	20.35
		6 wks. after				12.2	18.6
		Average				10.97	19.48
	8#/A	Immed. after block.				10.5	18.4
		6 wks. after				12.9	18.0
		Average				11.70	18.20
	16#/A	Immed. after block.				13.6	19.4
		6 wks. after				13.9	17.9
		Average				13.75	18.65
ACX-262	16 gal./acre	3 wks. after				7.9	19.6
	32 gal/A	3 wks. "				8.2	17.7
	64 gal/A	" " "				3.4	14.45
		Average				6.50	17.25
ACX-263	16 gal/A	" " "				6.0	20.7
	32 gal/A	" " "				10.5	18.4
	64 gal/A	" " "				11.6	17.85
		Average				9.37	18.98
ACX-264	16 gal/A	" " "				15.8	19.15
	32 gal/A	" " "				14.1	18.6
	64 gal/A	" " "				13.0	14.2
		Average				14.30	17.32

43 contineue.

Post-emergence - Fargo

Treatment	Rate	Date of Application	Ave. no. weeds per sq. meter Broad-leaf	Grass	Ave. no. beets per sq. meter	Wt. of 15 beet sample lbs.	Sugar %
ACX-184	64 gal./ acre	Immed. after block.				16.0	18.0
		Average				16.00	18.00
ACX-170	16 gal./ acre	Immed. after block.				19.0	19.55
		3 weeks after				16.7	15.7
		Average				17.85	17.63
	32 gal./ acre	Immed. after block.				16.6	18.2
		3 weeks after				5.9	20.3
		Average				11.25	19.3
	64 gal./ acre	Immed. after block.				5.7(6 beets)	19.3
		Average				5.70	19.30
NaCl	40 gal./ acre	Immed. after block.				15.2	20.6
		3 weeks after				13.9	19.3
		6 weeks after				12.5	20.2
		Average				13.87	20.03
	80 gal./ acre	Immed. after block.				19.2	19.65
		3 weeks after				18.1	19.15
		6 weeks after				15.2	20.9
		Average				17.50	19.90
	160 gal./ acre	Immed. after block.				20.4	18.3
		6 wks. after				20.2	19.0
		Average				20.30	18.43
KCl	40 gal./ acre	Immed. after block.				13.3	20.9
		3 wks. after				16.3	19.8
		6 wks. after				12.8	21.4
		Average				14.13	20.70
	80 gal./ acre	Immed. after block.				17.8	19.7
		3 wks. after				14.4	20.0
		6 wks. after				11.8	20.15
		Average				14.67	19.95
	160 gal./ acre	Immed. after block.				15.8	19.8
		6 wks. after				11.9	21.35
		Average				13.57	20.58
NaTCA	4#/A	Immed. after block.				11.7	19.2
		3 wks. after				13.4	18.7
		6 wks. after				13.0	19.35
		Average				12.70	19.08

43-continued.
Post-emergence - Fargo

Treatment	Rate	Date of Application	Ave. no. weed per sq. meter Broad-leaf	Grass	Ave. no. beets per sq. meter	Wt. of 15 beet sample lbs.	Sugar %
ACX-265	16 gal/A	3 wks. after				18.5	18.55
	32 gal/A	" " "				10.5	19.1
	64 gal/A	" " "				3.5	17.0
		Average				10.83	18.22
Controls						17.3	18.7
						18.6	18.2
						16.4	21.35
						13.9	20.4
						10.3	20.95
		Average				15.3	19.92

Table 41.
Effect of pre-emergence sprays with 2,4-D and oils on sugar beets. Andersen, E. T. and A. B. Mantell.

Treatments	Average Plot Yields in Lbs. of Pea Pods First Date	Second Date
2,4-D Ester at 0.25 lbs./acre	35.8	35.6
" " " 0.50 " "	37.1	36.4
" " " 1.00 " "	34.8	33.8
" Na Salt " 0.25 " "	38.5	33.5
" " " " 0.50 " "	36.8	37.6
" " " " 1.00 " "	42.5	33.8
1 part diesol fuel : 1 part water	33.8	35.6
1 " " " : 4 parts water	41.3	36.1
Shellsol at 60 gallons/acre	33.4	32.1

Mean of combined checks - 32.4

(Contribution of Division of Plant Science, University of Manitoba. Winnipeg.)

Project V. Investigation of Weed Control Methods in Horticultural and Truck Crops, Potatoes, and Sugar-Beets.

Table 46. Effect of Various Systemic (hormone) Herbicides on Potatoes and Common Weeds when the Crop was 8 inches High on Sandy Loam Soil. Saskatoon, Sask. 1948.

Contributed by Thomas K. Pavlychenko, Agric. Field Res., American Chemical Paint Co., Ambler, Pa.

(2) Chemical	Rate oz/A	Bu/A	Commercial size %	Condition of vines: Stunted	Condition of vines: Color	Ht. at maturity inch	(1) Weed control	Yield, bu/A untreated controls: not hill.	Yield, bu/A untreated controls: hill.
Wc. 48	2	99	64	0	deep grn.	14	fair	66	81
	4	90	65	slight	"	13	good	73	99
	8	109	63	mild	"	12	v.good	72	84
W. #5	8	116	67	slight	"	13	v.good	83	141
Wr. 64	2	84	65	0	"	14	fair	79	101
	4	91	65	0	"	14	good	87	113
LFN 472	2	68	66	0	lighter grn.	14	weak	86	115
	4	75	65	0	deep "	14	fair	68	100
95% MSS	2	86	64	0	lighter "	14	weak	58	89
	4	75	66	0	deep "	14	fair	67	92
W.N.M.	2	84	61	0	" "	14	Fair	79	73
	4	61	52	mild	v. dark "	12	v. good	78	86

(1) Weeds present: Common Wild mustard (Sinapis arvensis), Stinkweed (Thlaspi arvense), Russian Thistle (Salsola Kali), Wild Buckwheat (Polygonum convolvulus), Lambsquarters (Chenopodium album) and Redroot pigweed (Amaranthus retroflexus).

(2) Wc. 48 = Weedone concentrate 48, commercial ethyl ester; LFN 549 = ester of 2,4,5-T; W#5 = Weedone #5, ethyl ester; Wr. 64 = Weedar 64, amine salt; LFN 472 = 2,4-D acid; 95% MSS = 95% Monohydrate sodium salt; W.N.M. = Weed-no-more, butyl ester.

Project V. Investigation of Weed Control Methods in Horticultural and Truck Crops, Potatoes, Sugar Beets, Legumes, Etc.

Table 50. Effect of pre-emergence sprays with two formulations of 2,4-D on potatoes.

Contribution by Andersen, E. T. and A. B. Mantell, Division of Plant Science, Univ. of Manitoba, Winnipeg.

Average Plot Yields in Pounds of Potato Tubers

2,4-D (lbs./acre)	First date		Second date		Third Date	
	Ester	Sodium salt	Ester	Sodium salt	Ester	Sodium Salt
0.25	26.6	24.6	26.3	26.3	26.9	27.0
0.50	31.3	26.6	30.8	21.6	25.0	29.3
1.00	32.9	23.0	29.5	25.8	29.1	28.0
2.00	28.8	27.8	29.4	30.5	31.8	28.6

Mean of combined checks - 26.7
Necessary Difference - 5.55

Tabular Data

Supporting Abstracts on Newer Herbicides

Ab. 3 Effect of various rates and dates of application of TCA in the control of quackgrass (Agropyron repens) at Lamberton, Minnesota in 1947-1948. Stahler, L. M.

Date applied.	Growth condition of quackgrass.	Rate in pounds per acre	% survival of quackgrass July 6, 1948
June 1, 1947	Heavy growth--6-12"	100	22
June 1, 1947	shooting heads.	200	26
June 1, 1947		300	18
July 24, 1947	Dry, seed ripe, plants	100	2
July 24, 1947	dormant, grazed short.	200	4
July 24, 1947		300	2
Sept. 3, 1947	Succulent full	100	6
Sept. 3, 1947	growth, grazed--	200	4
Sept. 3, 1947	4-6 inches in height	300	9
Oct. 24, 1947	Foliage killed by	100	18
Oct. 24, 1947	frost--short grazed	200	15
Oct. 24, 1947		300	4

Ab. 4 Effect of IPC and TCA as herbicides to control quackgrass (Agropyron repens) at Lamberton, Minnesota in 1947-1948. Stahler, L. M.

Chemical used	Pounds per acre	How applied	Percent survival of quackgrass October 15, 1947	July 6, 1948
IPC	15	dry	100	100
IPC	30	dry	100	100
IPC	60	dry	100	100
IPC	120	dry	40	85
TCA	100	spray	10	30
TCA	200	spray	20	20
TCA	300	spray	2	20
TCA	400	spray	0	25

Ab. 16 Effects of 2,4-D, TCA, IPC and contact dinitro on the yields and test weight of flax, when applied as pre-emergence sprays. Derscheid, Lyle A., L. M. Stahler, D. E. Kratochvil. (Contributed by Agronomy Dept. of South Dakota Agri. Exp. Sta. and Bureau of Plant Industry, Soils and Agri. Eng. U.S.D.A.)

Treatment	Pounds per acre	Bushels per acre Seeding time	3 days after seeding
2,4-D	1	12.0	12.1
2,4-D	2	12.8	11.6
2,4-D	4	10.2	11.2
untreated	-	15.8	15.1
L.S.D.		6.75	6.75
TCA	6	11.4*	11.7
TCA	12	9.5*	8.8*
TCA	24	8.4*	8.4*
Untreated	--	14.8	12.4
L.S.D.		3.00	3.00
IPC	2	12.4	10.5
IPC	4	13.3	12.6
IPC	8	6.9	9.3
Untreated	-	11.2	13.7
L.S.D.		5.5	5.5
Dinitro	1	13.3	14.4
Dinitro	2	12.0	12.8
Dinitro	4	9.9	14.5
Untreated	-	13.3	14.5
L.S.D.		4.25	4.25

* Significantly lower, at 5% point, than untreated.

Ab. 18 The effects of 2,4-D and TCA on the yield of nine soybean varieties. Derscheid, Lyle and D.E. Kratochvil. (Contrbuted by the Agronomy Dept. of the South Dakota Agri. Exp. Station.)

Variety	¼ # 2,4-D	½ # 2,4-D	6 # TCA	16# TCA	Untreated	L.S.D. 5%	1%
Capital	19.0*	10.3**	4.2**	0.9**	27.9	7.7	9.0
Hawkeye	14.3*	6.8**	3.6**	0.6**	27.4	7.7	9.0
Lincoln	22.0	11.4**	2.2**	3.2**	23.7	7.7	9.0
Manchukota	16.9	10.4**	2.4**	0.5**	23.0	7.7	9.0
Richland	19.9**	17.6**	1.2**	3.1**	29.8	7.7	9.0
Ottawa Mandarin	16.8**	11.2**	2.6**	3.3**	26.8	7.7	9.0
Flambeau	18.9*	8.1**	4.5**	0.7**	26.7	7.7	9.0
Earlyana	17.2*	10.2**	4.2**	1.1**	26.1	7.7	9.0
Bavender Special	29.8	17.1**	2.2**	0.1**	28.9	7.7	9.0
Average	19.4**	11.5**	3.0**	1.3**	26.3	3.8	5.5

* - Significantly lower than untreated yield at 5% point
** - Significantly lower than untreated yield at 1% point

Ab. 19 Effect of herbicidal oils, oils fortified with PCP and sodium PCP in water spray, on weeds in flax and on yields and test weight of flax seed. Brookings, S.D. 1948. Stahler, L.M. and Lyle A. Derscheid.

Chemical used	Gallons per acre	Maturity at time of norm. full bloom.1/	Yield in bu. /A.	Test wt.lbs /bu.	% survival of weeds G 2/	B/
Shell Oil ACX 184. 4/	40.	A-	18.1	53.3	75	100
Shell Oil ACX 184	80.	B+	19.7	53.7	25	100
Shell ACX 170	40	B+	14.0	52.7	25	95
Shell ACX 170	80.	B-	12.1	52.5	7	100
Shell ACX 238	40	C	7.5	----	45	10
Shell ACX 237	40	C-	8.9	----	7	-1
Shell ACX 224	40	C	18.1	53.3	10	60
Shell ACX 224	80	C-	16.4	53.7	8	30
PCP in water 4#	40	B	19.0	54.2	80	20
PCP in water 8#	40	C+	17.7	54.1	80	5
Untreated checks.	--	A	18.8	54.5	100	100

1/ A - full bloom (normal): B full bud; C pre bud.
2/ G - grass weeds, Seteria spp. Echinochloa sp., Panicum spp. and Avena fatua.
3/ B - broad leaved weeds - Amaranthus spp., Polygenus spp., Ambrosia sp.
4/ Shell ACX - experimental herbicidal oils supplied by Shell Oil Laboratories., N.Y., New York. ACX 238, and ACX 237 contain 1.25% and 2.5% respectively PCP.

(Contribution of Bureau Plant Industry, Soils and Agri. Eng. of U.S.D.A. and Agronomy Dept., South Dakota State College.)

Ab. 27 Response of red clover and alfalfa seedlings to growth regulation and dinitro herbicides. Buchholtz, K. P. (Dept. Agronomy, Univ. of Wis., Madison, Wisconsin.)

Material	Rate of application	Stand as per cent of check Red Clover	Alfalfa
2,4-D as the ethyl ester	1 lb/acre	11**	3**
" " " isopropyl ester	"	30**	11**
" " " butyl ester	"	17**	6**
" " " sodium salt	"	115	70"
" " " ammonium salt	"	94	67**
" " " amine (Dow)	"	73	53**
" " " " (Powell)	"	16**	24**
" " " " (A.C.P.)	"	68	23**
2,4,5-T " isopropyl ester	"	4**	10**
MCP " " " "	"	144**	13**
DNOSBP as the ammonium salt	1 gal/acre (80 gal.water)	100	159**
" " " " "	1 gal/acre (40 gal.water)	94	154**
" " " " "	1 gal/acre (20 gal.water)	100	143**
Check - plants/sq. ft.		66	6.8
L.S.D. at the 5 per cent level		32 pct.	30
" " " 1 " " "		43	43

Ab. 30 Use of 2,4-D and related materials for pre-emergence weed control in corn. Buchholtz, K. P. (Dept. Agronomy, Univ. of Wisconsin, Madison, Wisconsin.

Material	Application lbs./acre	Cultivation	Corn emerg. pct.	Broad leaved weeds/ sq. ft.	Grassy weed/ sq. ft.	Yield bu. per acre
2,4-D as the sodium salt	1	-	92	1.9**	16.4	20.0**
" " " " "	2	-	94	1.0**	8.6**	36.1**
" " " " "	4	-	87	0.6**	4.3**	40.1**
" " " " "	2	+	93	---	---	58.1
2,4-D as the butyl ester	2	-	92	0.8**	9.2*	39.0*
2,4,5-T as the isopropyl ester	2	-	93	2.7**	8.4**	30.0**
MCP as the isopropyl ester	2	-	90	0.8**	5.9**	33.4**
Check 1	-	-	91	7.1	20.2	18.5
Check 2	-	+	93	-	-	60.8
L.S.D. at the 5 percent level			N.S.	2.5	8.4	9.4
" " " 1 " "			N.S.	3.4	11.4	12.5

Ab. 31 Effectiveness of several growth regulating substances for controlling the growth of purslane (Portulaca oleracea). Buchholtz, K. P. (Dept. of Agronomy, Univ. of Wisconsin, Madison, Wisconsin)

Material	Applic. lbs./A.	Purslane plants/sq. ft. Treatment Ave.	Material Ave.
2,4-D as the sodium salt	0.25	16.7	15.2
" " " " "	0.50	17.5	
" " " " "	1.00	11.5	
2,4-D as the amine	0.25	18.2	8.4
" " " "	0.50	5.6	
" " " "	1.00	1.5	
2,4-D as the butyl ester	0.25	2.6	1.3
" " " " "	0.50	0.9	
" " " " "	1.00	0.4	
2,4,5-T as the isopropyl ester	0.25	6.0	3.9
" " " " "	0.50	4.9	
" " " " "	1.00	0.8	
MCP as the isopropyl ester	0.25	8.0	5.5
" " " " "	0.50	3.6	
" " " " "	1.00	4.9	
Check	----	19.9	----
L.S.D. at the 5 percent level		7.9	4.6
" " " 1 " "		10.7	6.2

Effect of several herbicides on germination of sugar-beet seed. Swanson, Charles R.

Table 1. (Ab. 12) Effect of several concentrations of three herbicidal chemicals on root length of sugar-beet seedlings.

Concentration (ppm)	Average root length (per cent of control)		
	Na 2,4-D	*Dinitro	+ATCA
	%	%	%
0	100.0	100.0	100.0
25	33.3	84.2	102.0
100	28.6	61.7	104.4
250	24.9	39.2	108.8
500	24.0	26.4	103.0
1000	23.0	16.9	96.6
2000	20.0	14.0	87.7
4000	19.9	12.8	74.8

* Ammonium dinitro ortho secondary butyl phenol (Sinox W).
\+ Ammonium trichloroacetate

Table 2. (Ab. 12) Effect of ammonium trichloroacetate on rate of germination of sugar-beet seed.

Concentration (ppm)	Germination at given time intervals					
	17 hrs.	22 hrs.	26 hrs.	41 hrs.	46 hrs.	65 hrs.
	%	%	%	%	%	%
0	2.5	10.5	18.0	60.8	67.3	72.8
25	4.0	8.3	16.5	62.3	71.3	76.0
100	5.8	12.3	19.0	60.5	68.5	74.0
250	2.5	8.8	17.5	57.3	67.3	70.8
500	4.8	12.8	22.8	58.3	66.5	74.3
1000	1.8	7.3	17.3	56.0	66.5	75.0
2000	2.0	6.8	13.0	53.3	63.8	72.8
4000	1.8	5.3	12.0	43.3	55.5	69.3

C. J. Willard.

Table 3. Effect of Sinox W on rate of germination of sugar-beet seed. (Ab. 12)

Concentration (ppm)	Germination at given time intervals						
	17 hrs.	22 hrs.	25.5 hrs.	41 hrs.	46 hrs.	49.5 hrs.	65 hrs.
	%	%	%	%	%	%	%
0	3.3	6.8	12.0	51.5	61.3	63.3	70.0
25	3.0	5.3	9.0	45.5	57.3	62.0	73.3
100	0.3	3.0	7.0	45.8	51.0	57.3	67.0
250	0.8	1.8	2.8	34.3	44.0	50.0	65.0
500	0.0	0.3	1.5	17.8	26.0	33.0	53.3
1000	0.0	0.3	0.3	5.5	7.0	9.8	22.0
2000	0.0	0.0	0.0	2.0	2.3	2.5	5.8
4000	0.0	0.0	0.0	1.0	1.0	1.8	2.0

Table 4. Effect of Na 2,4-D on rate of germination of sugar-beet seed. (Ab. 12)

Concentration (ppm)	Germination at given time intervals						
	17 hrs.	22 hrs.	25 hrs.	41 hrs.	46 hrs.	49 hrs.	65 hrs.
	%	%	%	%	%	%	%
0	5.8	13.8	20.0	58.3	65.0	68.3	73.3
25	3.8	11.0	18.0	52.8	57.5	62.5	70.8
100	3.5	7.5	10.5	52.8	62.5	63.0	69.0
250	3.3	4.0	8.0	41.0	51.5	56.8	66.5
500	1.5	4.3	7.5	45.3	56.3	60.8	72.5
1000	1.3	3.0	6.0	31.8	44.8	51.3	59.8
2000	1.3	1.8	2.5	26.3	43.3	50.3	69.0
4000	1.0	1.5	1.8	11.3	19.0	29.3	45.8

(Contribution of Div. of Cereal Crops & Dis., Bur. of Plt. Ind., Soils & Agr. Engr. USDA.)